REPORT

FROM THE

SELECT COMMITTEE

ON

POTATO CROP;

TOGETHER WITH THE

PROCEEDINGS OF THE COMMITTEE,

MINUTES OF EVIDENCE,

AND APPENDIX.

Ordered, by The House of Commons, *to be Printed,*
9 *July* 1880.

274—Sess. 2.

Ordered,—[*Friday*, 21*st May* 1880]:—THAT a Select Committee be appointed to inquire into the best means of diminishing the frequency and the extent of Failures in the POTATO CROP.

Committee nominated—[*Friday*, 4*th June* 1880]—of—

Mr. Arthur Moore.
Sir Hervey Bruce.
Mr. Macdonald.
Sir Edmund Filmer.
Mr. Earp.
Mr. Macartney.
Mr. Barclay.
Mr. Stewart.
Lord Moreton.
Mr. Storer.
Mr. Colman.
Mr. Round.
Mr. Evans.
Mr. Tottenham.
Major Nolan.

THAT the Committee have power to send for Persons, Papers, and Records.

THAT Five be the Quorum of the Committee.

Ordered,—[*Friday*, 11*th June* 1880]:—THAT the Committee do consist of Seventeen Members.

THAT Mr. Creyke and Mr. Lalor be added to the Committee.

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R E P O R T.

THE SELECT COMMITTEE appointed to inquire into the best Means of Diminishing the Frequency and the Extent of Failures in the POTATO CROP;——HAVE agreed to the following REPORT:—

YOUR Committee having from its formation been of opinion that its primary duty consisted in the collection of evidence, summoned several gentlemen who, by their official position, or from their writings, might be supposed to be specially acquainted with the botanical or chemical aspect of the Potato Disease.

The list of scientific witnesses included:—

Mr. W. T. Thistleton Dyer, Assistant Director of the Royal Gardens at Kew.
Mr. H. Carruthers, F.R.S., Head of the Botanical Department of the British Museum.
Professor T. Baldwin, Superintendent of Agricultural Department of the National Board, Ireland.
Dr. A. Voeckler, PH.D., F.R.S., Consulting Chemist of the Royal Agricultural Society of England.
Mr. Worthington Smith, F.R.S., and Fellow of the Linnæan Society.

Your Committee have also heard the evidence of the following growers of potatoes:—

Mr. Crighton, Arbroath, Forfarshire.
Mr. Thomas M. Nicoll, Forfarshire.
Mr. Charles Rintoul, East Lothian.
Mr. W. Ritchie, East Lothian.
Mr. J. Robertson, County Dublin.
Mr. J. May, Kent.
Mr. S. Coleman, Londonderry.

A third class of witnesses included Mr. John Nicoll, who originally produced the Champion potato from the seed; Mr. William Ingram, Belvoir Castle; Mr. Shuter, potato salesman; Mr. H. Thompson, who had a specific remedy the nature of which he did not disclose.

Your Committee have examined all witnesses who actually presented themselves in the committee-room, but have been obliged to make a selection from the numerous witnesses at a distance who were anxious to be examined.

The evidence of the scientific witnesses seems to have clearly agreed on the nature of the disease, which according to them coosists in the growth of a fungus, *Peronospora infestans*, on or in the plant.

One witness, Mr. Worthington Smith, declared that there were two distinct although closely allied fungi, *Peronospora infestans* and *Fusisporium solani*, but as the attributes of both fungi are nearly identical, it does not seem to be at present of much practical importance to determine whether the disease coosists in one or two closely allied fungi.

The scientific witnesses agreed in their belief that the disease spread during the summer by means of spores or seeds, which first attack the leaves or haulms of the plant, the disease then descending to the tubers.

The scientific witnesses were agreed that a single fungus would produce thousands of millions of such spores, and that each of these spores would be capable in a very short time, certainly not exceeding 48 hours, of becoming a developed fungus, and of producing fresh spores.

This

This almost inconceivable fecundity accounts for the rapid spread of the disease during the summer.

An examination of the evidence will however disclose one important point of difference between the scientific witnesses, some of these gentlemen asserting that the spores are wafted considerable distances by the wind or atmosphere, while others argue that, as a general and practical rule, the spores might be considered as incapable of being borne to a distance by the wind. Most of the witnesses, however, agreed that the spores could be and were largely conveyed from place to place by birds, ground game, insects, and by unconscious human agency.

The second important point on which the scientific witnesses were examined was the manner in which the disease was carried over from year to year through the winter.

The scientific witnesses generally agreed that the spores which during the summer extend the disease from plant to plant with fearful rapidity were incapable of living over the winter, but as to how the disease hybernated there was again a difference of opinion.

Some witnesses (without actually denying the existence of resting spores) believed that the disease was mainly carried over the winter by the *mycelium* (the filaments which constitute the body of the fungus), which remains sometimes attached to the outside, sometimes within the skin of the potato. According to these gentlemen, the disease would generally be planted with the potato seed, although it might to a lesser degree remain on the old stalks and be spread with the manure.

Other witnesses attach great importance to resting spores; these spores are sexually vitalised spores, with an infinitely greater vitality than the ordinary spores, and those of the *Peronospora infestans* are capable of living undeveloped and exposed to the ordinary vicissitudes of climate for as long as three years (according to Mr. Worthington Smith). If the theory of resting spores be accepted in its entirety, then the disease would be largely carried over the winter, not only in the seed potato, but in the stalks, the manure heap, and in the ground itself.

The chief essential conditions for the full development and rapid spread of the disease, seem to be the coincidence of moist weather, with a particular stage of the growth of the plant and development of the fungus; as a rule, the time in which excessive moisture is to be most dreaded is during the last two weeks of July, and the first two of August. Individual instances of the disease appear, however, sometimes as early as May.

None of the scientific witnesses connected the spread of the disease directly with electrical phenomena, although the conditions of moisture and perhaps of heat usually attending or immediately preceding thunder storms, are most favourable to the rapid propagation of the fungus.

There is a conflict of testimony as to whether the disease was introduced into this country in 1845, or whether it existed in a modified form long antecedent to that date, its virulence being then strongly developed in consequence of the exceptional weather of that period.

The scientific witnesses concurred in the opinion that it is advisable to take the precaution of burning the stalks of diseased potatoes, so that neither the diseased stalks nor tubers should be thrown upon the land or the manure heap, but that if the tubers be used for feeding purposes they should be previously boiled; as if consumed in a raw state there is no guarantee that the spores of the disease would be effectually destroyed.

All strongly objected to sowing a second crop of potatoes within a certain period in the same land; those who believed in resting spores having a greater objection than the others.

With regard to manures, no specific against the disease was even suggested, although the want of potash, where seaweed is not used, was alleged to be very marked on the smaller farms in Ireland.

Any anti-fungus or caustic preparation applied to the seed or the soil would be on the whole beneficial, but, as far as our knowledge extends, unlikely to arrest the disease.

All the witnesses agreed that it seemed hopeless to prevent the spread of the disease when it had once set in, except possibly, according to some, by cutting

cutting or pulling the stalks, which proceeding would prevent the ripening of the potato, and lessen the weight of the crop secured.

Only one witness, Professor Baldwin, believed in the possibility of stamping out the disease. The scientific witnesses concurred in believing that it was possible and probable that we might find or develop varieties of potatoes which would be more capable of resisting the disease than those hitherto produced; they also believed that if an early potato could be extensively grown it might be ripened before the usual time for the development of the fungus. With regard to storing the crop, the scientific witnesses urged the necessity of preventing vegetable fermentation, which by causing heat favours the growth of the fungus; coolness and ventilation are the points to be studied, particularly with regard to potatoes for seed purposes.

The scientific points on which further proofs seem necessary are, first, as to whether the summer spores are borne by the atmosphere to considerable distances, and, secondly, as to how the disease is carried over the winter, whether by resting spores, or by the mycelium, whether mainly in the seed, the ground, or the manure heap.

The necessity for the production of new varieties is concurred in by all witnesses.

The evidence of the growers of potatoes pointed to the advisability of drainage, of judicious manuring, and of good cultivation, but all confessed that none of these remedies, or even all combined, were sufficient to insure perfect safety to the crop.

The large growers seem to have been all most careful in the choice of their seed, and anxious to obtain it from a district different from their own. To rear the seed at a higher altitude than that in which the market crop was grown was much dwelt on.

The growers agreed that within their experience many varieties of potatoes had disappeared, having become utterly worn out, and that all had deteriorated in their disease-resisting powers, although at the same time the edible qualities of the potato considerably improve as each variety of the potato recedes from the seed.

The general testimony of the growers led to the conclusion that each variety derived from the seed takes four to six years to be really established, and that then it is often worthless, but that if it should turn out to be a valuable class of potato it steadily improves in flavour by cultivation; however, after a certain time, any comparative immunity from disease which it may originally possess disappears.

With good cultivation the time at which a new variety might be expected to degenerate would be about 20 years after its establishment.

All the witnesses bore testimony to the great disease-resisting powers up to the present date of the Champion potato; they also warned the Committee that the Champions must be expected to succumb in their turn.

With regard to the cultivation of the potato in Ireland, it was shown that the great bulk are produced by small farmers; that they often sow every second year in the same ground; that no precautions are taken against propagating the disease from year to year through the stalks; that the smallest potatoes are habitually used for seed, and that above all there is no change of seed.

It seems also clear that where seaweed is not used, a sufficiency of potash is rarely restored to the soil by the tillers of small plots.

Your Committee are of opinion that the larger growers of the potato in Scotland, in England, and in some parts of Ireland, such as the counties of Dublin and Louth, are, in all matters which are included in the ordinary business of a farmer, well able to look after their own interests; but that the creation of new varieties of potatoes cannot be considered to be included in the ordinary business of a farmer. On the other hand, it may be said that the great mass of potato producers in Ireland, and possibly to a lesser extent the cultivators of small plots in Great Britain, have not, up to the present time, taken the most ordinary precautions to produce a certain and healthy crop, and that this class of small holders might be easily benefited at a small cost to the Government.

Your Committee are of opinion that the production of new varieties of the potato, from seed, or possibly the improvement of existing varieties by a careful

careful selection of tubers, is of considerable national importance; at the same time, this creation of new varieties does not seem to offer to the individual who devotes himself to their production, much hope of remuneration.

Under these circumstances it would seem that the search for new varieties must be undertaken, either by the combined enterprise of the larger potato growers, working through such societies as the Royal Agricultural Societies of England or Ireland, and the Highland Society, or by the Government; as up to the present but little has been effected by the former plan, it would seem time for the Government to lend assistance.

Your Committee are of opinion that experimental undertakings for the creation and establishment of new varieties of the potato should be encouraged in England, Scotland, and Ireland. Whether this should be done under direct Government control, or under that of existing Agricultural Societies, subsidised by Government, is a point which might with advantage be determined differently in the different countries.

In Ireland the best plan would probably be to further extend the farms of the Agricultural Department of the National Board, and to specifically direct the attention of the superintendent of these farms to researches on the potato disease, and to the creation, the selection, and establishment of new varieties of the potato.

In England and Scotland it might be advisable to consult with the leading agricultural societies as to whether, if subsidised, they would undertake the necessary work, subject to Government inspection and control; should these societies decline the task, your Committee are distinctly of opinion that the Government should appoint in each country a superintendent, who should conduct the necessary experiments, and who should endeavour to furnish new and successive disease-resisting varieties of potatoes.

Whether land should be secured permanently or otherwise for producing new varieties of the potato, and encouragement should be given to farmers and private producers of new varieties, are points of detail which might safely be left to the superintendents to determine.

Your Committee are further of opinion, that in Ireland, provision should be made by authority of the Government for supplying good seed potatoes to small growers for cash payments.

9 *July* 1880.

PROCEEDINGS OF THE COMMITTEE.

Wednesday, 9th June 1880.

MEMBERS PRESENT:

Mr. Evans.
Mr. Storer.
Sir Hervey Bruce.
Mr. Colman.
Major Nolan.
Lord Moreton.
Mr. Tottenham.
Mr. Earp.
Mr. Barclay.
Mr. Round.
Mr. Arthur Moore.
Mr. Stewart.

Major NOLAN was called to the Chair.

The Committee deliberated.

[Adjourned till Tuesday next, at Twelve o'clock.

Tuesday, 15th June 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Mr. Macdonald.
Mr. Earp.
Mr. Tottenham.
Mr. Barclay.
Sir Edmund Filmer.
Mr. Storer.
Mr. Stewart.
Mr. Creyke.
Mr. Round.
Mr. Colman.
Mr. Macartney.
Sir Hervey Bruce.
Mr. Arthur Moore.

Mr. *W. T. Thistleton Dyer*, Mr. *William Carruthers*, Mr. *James Crighton*, and Mr. *John Nicoll*, were severally examined.

[Adjourned till Friday next, at Twelve o'clock.

Friday, 18th June 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Mr. Macartney.
Mr. Macdonald.
Mr. Barclay.
Sir Hervey Bruce.
Mr. Stewart.
Sir Edmund Filmer.
Mr. Round.
Mr. Earp.
Mr. Colman.
Mr. Creyke.

Mr. *T. Nicoll*, Mr. *Rintoul*, and Mr. *William Ritchie*, were severally examined.

[Adjourned till Tuesday next, at Twelve o'clock.

Tuesday, 22*nd June* 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Sir Hervey Bruce.
Mr. Macartney.
Mr. Storer.
Sir Edmund Filmer.
Mr. Evans.
Lord Morton.
Mr. Macdonald.
Mr. Stewart.
Mr. Arthur Moore.
Mr. Round.
Mr. Earp.
Mr. Colman.
Mr. Barclay.
Mr. Tottenham.
Mr. Creyke.

Mr. *John Robertson*, Mr. *James May*, Mr. *Samuel Coleman*, and Mr. *William Ingram* were severally examined.

[Adjourned till Friday next, at Twelve o'clock.

Friday, 25*th June* 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Mr. Arthur Moore.
Mr. Macdonald.
Mr. Stewart.
Mr. Round.
Sir Edmund Filmer.
Mr. Storer.
Mr. Colman.
Mr. Earp.
Sir Hervey Bruce.
Mr. Barclay.
Mr. Tottenham.
Mr. Macartney.

Professor *Baldwin* and Dr. *Augustus Voeckler* were severally examined.

[Adjourned till Tuesday next, at Twelve o'clock.

Tuesday, 29*th June* 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Mr. Macdonald.
Sir Hervey Bruce.
Mr. Arthur Moore.
Sir Edmund Filmer.
Mr. Storer.
Mr. Colman.
Mr. Earp.
Mr. Stewart.
Mr. Barclay.
Mr. Round.

Mr. *Henry Thompson*, Mr. *Worthington G. Smith*, and Mr. *James Legosick Shuter* were severally examined.

[Adjourned till Friday next, at Twelve o'clock.

Friday, *2nd July* 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Lord Moreton.
Sir Hervey Bruce.
Sir Edmund Filmer.
Mr. Storer.
Mr. Stewart.
Mr. Macdonald.
Mr. Round.
Mr. Arthur Moore.
Mr. Macartney.
Mr. Earp.
Mr. Colman.

Professor *Baldwin* was further examined.

[Adjourned till Friday next, at Twelve o'clock.

Friday, *9th July* 1880.

MEMBERS PRESENT:

Major NOLAN in the Chair.

Lord Moreton.
Sir Hervey Bruce.
Sir Edmund Filmer.
Mr. Storer.
Mr. Colman.
Mr. Creyke.
Mr. Evans.
Mr. Earp.
Mr. Macdonald.
Mr. Round.

DRAFT REPORT proposed by the *Chairman*, read the first time, as follows:—

"1. YOUR Committee having from its formation been of opinion that its primary duty consisted in the collection of evidence, summoned several gentlemen who, by their official position, or from their writings, might be supposed to be specially acquainted with the botanical or chemical aspect of the Potato Disease.

"2. The list of scientific witnesses included:—

"Mr. W. T. Thistleton Dyer, Assistant Director of the Royal Gardens at Kew.
"Mr. H. Carruthers, F.R.S., Head of the Botanical Department of the British Museum.
"Professor T. Baldwin, Superintendent of Agricultural Department of the National Board, Ireland.
"Dr. A. Voeckler, PH.D., F.R.S., Consulting Chemist of the Royal Agricultural Society of England.
"Mr. Worthington Smith, F.R.S., and Fellow of the Linnæan Society.

"3. Your Committee have also heard the evidence of the following growers of potatoes:—

"Mr. Crighton, Arbroath, Forfarshire.
"Mr. Thomas M. Nicoll, Forfarshire.
"Mr. Charlee Rintoul, East Lothian.
"Mr. W. Ritchie, East Lothian.
"Mr. J. Robertson, County Dublin.
"Mr. J. May, Kent.
"Mr. S. Coleman, Londonderry.

"4. A third class of witnesses included Mr. John Nicoll, who originally produced the Champion potato from the seed; Mr. William Ingram, Belvoir Castle; Mr. Shuter, potato salesman; Mr. H. Thompson, who had a specific remedy the nature of which he did not disclose.

"5. Your Committee have examined all witnesses who actually presented themselves in the committee-room, but have been obliged to make a selection from the numerous witnesses at a distance who were anxious to be examined.

"6. The evidence of the scientific witnesses seems to have clearly agreed on the nature of the disease, which according to them consists in the growth of a fungus, *Peronospora infestans*, on or in the plant.

"7. One witness, Mr. Worthington Smith, declared that there were two distinct although closely allied fungi, *Peronospora infestans* and *Fusisporium solari*, but as the attributes of both fungi are nearly identical, it does not seem to be at present of much practical importance to determine whether the disease consists in one or two closely allied fungi.

"8. The scientific witnesses agreed in their belief that the disease spread during the summer by means of spores in seeds, which first attack the leaves or haulms of the plant, the disease then descending to the tubers.

"9. The scientific witnesses were agreed that a single fungus would produce thousands of millions of such spores, and that each of these spores would be capable in a very short time, certainly not exceeding 48 hours, of becoming a developed fungus, and of producing fresh spores.

"10. This almost inconceivable fecundity accounts for the rapid spread of the disease during the summer.

"11. An examination of the evidence will, however, disclose one important point of difference between the scientific witnesses, some of these gentlemen asserting that the spores are wafted considerable distances by the wind or atmosphere, while others argue that, as a general and practical rule, the spores might be considered as incapable of being borne to a distance by the wind. Most of the witnesses, however, agreed that the spores could be and were largely conveyed from place to place by birds, ground game, insects, and by unconscious human agency.

"12. The second important point on which the scientific witnesses were examined was the manner in which the disease was carried over from year to year through the winter.

"13. The scientific witnesses agreed that the ordinary spores which during the summer extend the disease from plant to plant with fearful rapidity were incapable of living over the winter, but as to how the disease hybernated there was again a difference of opinion.

"14. Some witnesses (without actually denying the existence of resting spores) believed that the disease was mainly carried over the winter by the *mycelium*, the filaments which constitute the body of the fungus, which remains sometimes attached to the outside, sometimes within the skin of the potato. According to these gentlemen, the disease would generally be planted with the potato seed, although it might to a lesser degree remain on the old stalks and be spread with the manure.

"15. The other school attach great importance to resting spores; these spores are sexually vitalised spores, with an infinitely greater vitality than the ordinary spores, and capable of living undeveloped and exposed to the ordinary vicissitudes of climate for as long as three years (according to Mr. Worthington Smith). If the theory of resting spores be accepted in its entirety, then the disease would be largely carried over the winter, not only in the seed potato, but in the stalks, the manure heap, and in the ground itself.

"16. All the witnesses united in asserting that the first diseased plants were attacked in the tubers; that the disease then worked its way up above ground, and developed spores, which, if the conditions of weather were favourable, afterwards attacked the other plants invariably above ground.

"17. The chief essential condition for the full development and rapid spread of the disease, seems to be the coincidence of moist weather, with a particular stage of the growth of the fungus; as a rule, the time in which excessive moisture is to be most dreaded is during the last two weeks of July, and the first two of August. Individual instances of the disease appear, however, sometimes as early as May.

"18. Some of the scientific witnesses connected the spread of the disease directly with electrical phenomena, although the conditions of moisture and perhaps of heat usually attending or immediately preceding thunder storms, are most favourable to the rapid propagation of the fungus.

"19. As to whether the disease was introduced into this country about the year 1845, or whether it existed for a period long antecedent to that date, there is a remarkable conflict of testimony.

"20. The scientific witnesses concurred in believing that burning the stalks and getting rid of the diseased potatoes would be useful, although a very different amount of value was attached by the various witnesses to these steps.

"21. All strongly objected to sowing a second crop of potatoes within a certain period in the same land; those who believed in resting spores having a greater objection than the others.

"22. With

"22. With regard to manures, no specific against the disease was even suggested, although the want of potash, where seaweed is not used, was alleged to be very marked on the smaller farms.

"23. Any anti-fungus or caustic preparation applied to the seed or the soil would be on the whole beneficial, but, as far as our knowledge extends, unlikely to stop the disease.

"24. All the witnesses agreed that it seemed hopeless to arrest the spread of the disease once it had set in, except possibly, according to some, by cutting or pulling the stalks, which proceeding would prevent the ripening of the potato.

"25. Only one witness, Professor Baldwin, believed in the possibility of stamping out the disease. The scientific witnesses concurred in believing that it was possible and probable that we would find or develop varieties of potatoes which would be more capable of resisting the disease than those hitherto produced; they also believed that if an early potato could be extensively grown it might be ripened before the usual time for the development of the fungus. With regard to storing the crop, the scientific witnesses urged the necessity of preventing vegetable fermentation, which by causing heat favours the growth of the fungus; coolness and ventilation are the points to be studied.

"26. The scientific points on which further proofs seem necessary are, first, as to whether the summer spores are borne by the atmosphere to considerable distances, and secondly, as to how the disease is carried over the winter, whether by resting spores, or by the mycelium, whether mainly in the seed, the ground, or the manure heap.

"27. The necessity for the production of new varieties is concurred in by all witnesses.

"28. The evidence of the growers of potatoes pointed to the advisability of drainage, of judicious manuring, and of good cultivation, but all confessed that none of these remedies or even all combined, were sufficient to ensure safety to the crop.

"29. The large growers seem to have been all most careful in the choice of their seed, and anxious to obtain it from a district different from their own. To rear the seed at a higher altitude than that in which the market crop was grown was much dwelt on; where this could not be practised, seed, it was suggested, should be procured from soils in which the potato did not fully ripen.

"30. The growers agreed that within their experience many varieties of potatoes had disappeared, having become utterly worn out, and that all had deteriorated in their disease-resisting powers, although at the same time the edible qualities of the potato become considerably improved as each variety of the potato recedes from the seed.

"31. The general testimony of the growers led to the conclusion that each variety derived from the seed takes four to six years to be really established, and that then it is often worthless, but that if it should turn out to be a valuable class of potato it steadily improves in favour by cultivation; but after a certain time any comparative immunity from disease which it may originally possess disappears.

"32. With good cultivation the time at which a new variety might be expected to degenerate would be about 20 years after its establishment.

"33. All the witnesses bore testimony to the great disease-resisting powers up to the present date of the Champion potato; they also warned the Committee that the Champions must be expected to succumb in their turn.

"34. With regard to the cultivation of the potato in Ireland, it was shown that the great bulk are produced by small farmers; that they often sow every second year in the same ground; that no precautions are taken against propagating the disease from year to year through the stalks; that the smallest potatoes are habitually used for seed, and that above all there is no change of seed.

"It seems also clear that where seaweed is not used, a efficiency of potash is rarely restored to the soil by the tillers of small plots.

"35. Your Committee are of opinion that the larger growers of the potato in Scotland, in England, and in some parts of Ireland, such as the counties of Dublin and Louth, are in all matters which are included in the ordinary business of a farmer, well able to look after their own interests; but that the creation of new varieties of potatoes cannot be considered to be included in the ordinary business of a farmer. On the other hand, it may be said that the great mass of potato producers in Ireland, and possibly to a lesser extent the cultivators of small plots in Great Britain, have not, up to the present time, taken the most ordinary precautions to produce a certain and healthy crop, and that this class of small holders might be easily benefited at a small cost to the Government.

"36. Your Committee are of opinion that the production of new varieties of the potato, whether from the seed, or possibly from a careful selection of tubers, is of considerable national importance; at the same time, this creation of new varieties does not seem to offer to the individual who devotes himself to their production, much hope of remuneration.

"37. Under these circumstances it would seem that the search for new varieties must be undertaken, either by the combined enterprise of the larger potato growers, working through such societies as the Royal Agricultural Societies of England or Ireland, and the Highland Society, or by the Government; as up to the present but little has been effected by the former plan, it would seem time for the Government to lend assistance.

"38. Your Committee are of opinion that experimental farms for the creation and establishment of new varieties of the potato should be established in England, Scotland, and Ireland. Whether these farms should be placed under direct Government control, or under that of existing agricultural societies, subsidised by Government, is a point which might with advantage be determined differently in the different countries.

"39. In Ireland the best plan would probably be to extend the existing farms of the Agricultural Department of the National Board, and to specifically direct the attention of the superintendent of these farms to researches on the potato disease, and to the creation, the selection, and establishment of new varieties.

"40. In England and Scotland it might be advisable to consult with the leading agricultural societies as to whether, if subsidised, they would undertake the necessary work, subject to Government inspection and control; should these societies decline the task, your Committee are distinctly of opinion that the Government should appoint in each country a superintendent, who should conduct the necessary experiments, and who should endeavour to furnish new and successive disease-resisting varieties of potatoes.

"41. Whether a permanent farm or farms should be selected for the cultivation of the new varieties of the potato, whether arrangements should be entered into with farmers and with private producers of new varieties, and as to whether land should be temporarily hired for the various purposes in the different parts of the kingdom, are points of detail which might safely be left to the superintendents to determine.

"42. Your Committee are further of opinion that, in Ireland, power should be given to boards of guardians to supply seed for cash payments."

Draft Report read a second time, and considered, paragraph by paragraph.

Paragraphs 1—15, *agreed to*, with Amendments.

Paragraph 16, *postponed*.

Paragraphs 17—18, amended, and *agreed to*.

Paragraph 19, *disagreed to*.

New Paragraph—"There is a conflict of testimony as to whether the disease was introduced into this country in 1845, or whether it existed in a modified form long antecedent to that date, its virulence being then strongly developed in consequence of the exceptional weather of that period"—(Mr. *Colman*)—inserted in the proposed Report.

Paragraph 20, *postponed*.

Paragraphs 21 and 22, *agreed to*.

Paragraph 23.—An Amendment made in line 3, by leaving out the word "stop."—Another Amendment proposed, to insert the words "stamp out"—(Sir *Hervey Bruce*)—instead thereof.—Question put, That the word "stamp out" be there inserted.—The Committee divided:

Ayes, 3.	Noes, 7.
Mr. Colman	Mr. Storer.
Lord Moreton.	Sir Edmund Filmer.
Sir Hervey Bruce.	Mr. Creyke.
	Mr. Macdonald.
	Mr. Evans.
	Mr. Earp.
	Mr. Round.

Another Amendment proposed to insert the word "arrest"—(Sir *Edmund Filmer*).—Question, That the word "arrest" be there inserted,—put, and *agreed to*.

Question, That this paragraph, as amended, stand part of the proposed Report,—put, and *agreed to*.

Paragraphs 24—40, *agreed to*, with Amendments.

Paragraph 41, *disagreed to*.

New Paragraph—"Your Committee are further of opinion, that in Ireland provision should be made by authority of the Government for supplying good seed potatoes to small growers for cash payments"—(Mr. *Colman*)—inserted in the proposed Report.

Paragraph 42, amended, and *agreed to.*

Postponed Paragraph 16, *disagreed to.*

Postponed Paragraph 20.—Amendment proposed, after the word "concurred," to insert "in the opinion that it is advisable to take the precaution of burning the stalks of diseased potatoes, that neither the diseased stalks nor tubers should be thrown upon the land or the manure heap, but that if the tubers be used for feeding purposes they should be previously boiled"—(Mr. *Round*).—Question, That those words be there inserted,—put, and *agreed to.*

Another Amendment proposed, after the last word "boiled," to add the words, "as if consumed in a raw state, there is no guarantee that the spores of the disease would be effectually destroyed"—(Mr. *Colman*).—Question, That those words be there added,—put, and *agreed to.*

Question, That this paragraph, as amended, stand part of the proposed Report,—put, and *agreed to.*

Question, That this Report, as amended, be the Report of the Committee to the House,—put, and *agreed to.*

Ordered, To Report, together with Minutes of Evidence, and an Appendix.

EXPENSES OF WITNESSES.

NAME OF WITNESS.	PROFESSION OR CONDITION.	From whence Summoned.	Number of Days Absent from Home, under Orders of Committee.	Allowance during Absence from Home.	Expenses of Journey to London and Back.	TOTAL Expenses allowed to Witness.
				£. s. d.	£. s. d.	£. s. d.
James Crighton -	Gentleman - -	Arbroath -	3	3 3 –	6 13 –	9 16 –
John Nicoll - -	Manager of Arbroath Cemetery Company.	Arbroath -	3	3 3 –	6 13 –	9 16 –
T. M. Nicoll - -	Agriculturist -	Eassie, Forfar	5	5 5 –	6 15 –	12 – –
Charles Rintoul -	Agriculturist -	Edinburgh -	3	3 3 –	5 15 –	8 18 –
William Ritchie -	Agriculturist -	Dunver -	3	3 3 –	5 15 –	8 18 –
Samuel Coleman -	Agriculturist -	Coleraine -	5	5 5 –	5 – –	10 5 –
John May - -	Agriculturist -	Farningham	1	1 1 –	– 10 –	1 11 –
T. Baldwin - -	Superintendent of Agricultural Department of National Board.	Dublin -	5	3 3 –	5 9 –	8 12 –
W. Ingram - -	Gardener - -	Grantham -	2	1 10 –	1 15 –	3 5 –
					TOTAL - - - £.	72 15 –

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Mr. John Nichol - 23

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MINUTES OF EVIDENCE.

Tuesday, 15*th June* 1880.

MEMBERS PRESENT:

Mr. Barclay.
Sir Hervey Bruce.
Mr. Colman.
Mr. Creyke.
Mr. Earp.
Sir Edmund Filmer.
Mr. Macartney.
Mr. Macdonald.
Mr. Arthur Moore.
Major Nolan.
Mr. Round.
Mr. Stewart.
Mr. Storer.
Mr. Tottenham.

MAJOR NOLAN, IN THE CHAIR.

Mr. W. T. THISELTON DYER, M.A., F.R.S., called in; and Examined.

Mr. *Dyer*, M.A., F.R.S.

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Chairman.

1. I BELIEVE you are the Assistant Director of the Kew Gardens?—Yes; the Royal Gardens at Kew.

2. Amongst other botanical investigations I believe your attention has been directed to the growth of the potato plant, and the diseases of the potato plant, has it not?—Yes, in a general way; I have not made the disease of the potato plant a special study; but I am acquainted with the present state of scientific knowledge with regard to its history, and I have also had occasion to verify for myself the facts which are stated in the literature of the subject.

3. This is chiefly a practical Committee, and we are very anxious to obtain some scientific information on the subject of the potato disease; and if you will give us a short sketch of what the potato disease is, I think it would be very advantageous for the purposes of this Committee?—I brought down for the better information of the Committee a rough diagram, which was prepared some time since by Mr. Worthington Smith, who has also paid some attention to the life history of the fungus which I may say is generally accepted as being the cause of the potato disease; and, perhaps, if the Committee will allow me, I may make use of this diagram in illustration of the short account I have to give. The potato disease, I think, is now generally acknowledged to be the result of the depredations of a fungus upon the potato plant. I presume the Committee will apprehend that point, and I may add that, putting scientific technicalities rather aside, it will be perhaps sufficient to describe the potato fungus as what is ordinarily called a mould. It is somewhat similar to the moulds with which everyone is familiar which attack decaying organic substances, especially when exposed to damp; but it differs from such moulds in attacking in this particular case a living plant, and by the breaking down of the tissues of the living potato plant which the fungus effects in its growth, it inflicts upon it those mortal injuries which destroy its life. That, I think, is in a general way the best manner of stating what is the relation of the fungus to the plant upon which it feeds. It is rather difficult to select a point at which to commence what one may call the biography of this potato fungus. Perhaps it would be best to commence with the period at which it attracts the attention of the farmers in practical agriculture. This, I believe, usually occurs in the autumn or in the late summer, especially when the autumn or late summer has been characterised by periods of warm rain. It is not necessarily the case that the appearance of the potato fungus should be limited to that period of the year, but I believe, as a matter of fact, in the majority of cases, where it has been a serious cause of loss to the farmer, that that has practically happened. What is first observed, as I suppose every one knows, is that the foliage of the potato plant exhibits a certain yellowish tinge, which, of course, I need hardly say in all plants is regarded as a symptom of ill-health, and this yellow tinge is aggravated in places by the

Chairman—continued.

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Chairman—continued.

the appearance of discoloured spots. When those discoloured spots are examined, and the leaf is lifted up, on its under side there is generally to be observed a white flocculent—I can hardly call it exudation, but a white flocculence will be a sufficient explanation. When some of this white flocculence is examined by the aid of the microscope, the flocculi are found to consist of branched filaments, such as are represented in the lower part of the diagram, and those branched filaments have peculiarities of structure which have been very carefully studied, the best work on the subject having been that of Professor De Bary of the University of Strasburg. I do not know whether I need trouble the Committee, however interesting to a scientific man, with the details of structure of this part of the plant. Perhaps Mr. Carruthers, who I believe will be afterwards examined, will supplement that information if it is thought necessary. But the main fact is that the branches of these filaments have a peculiar knotted structure, which is highly characteristic of the fungus, and which is due to the peculiar mode in which certain ovoid bodies are developed from the branches. The fact is, that the end of the branch develops one of these ovoid bodies, and when that is matured the ovoid body is turned aside, usually falls off, and the end of the branch goes on growing and produces another. That is not well shown in the diagram, but that is a condition of things which is highly characteristic of the potato fungus in a scientific point of view. Now, turning our attention to these ovoid bodies, one of them in its mature state is represented in a very rough manner and much magnified; it will be observed that the contents of the ovoid body break up into a number of portions, varying from three to eight, and these are constituted of that substance which is practically familiar to everyone now, and which scientific men call protoplasm. After a time the ovoid body ruptures, especially if the atmosphere is in a damp condition; no doubt the case of the ovoid body absorbs moisture, and that promotes its disruption by the augmentation of the internal pressure. However that may be, the contents come out, and each is then seen to be furnished with two whip-lash filaments, which are also protoplasmic, and which are capable of moving backwards and forwards with very considerable vibratile velocity. The result is that if the leaves of the potato of the plant are bedewed with rain, or with the night dew, these bodies are capable of moving about in the film of moisture upon the foliage, and there can be little doubt that by the concussion of one potato plant with another, by the mere action of the wind, the films of moisture are placed in contact, and so one centre of infection is capable in an ever-widening circle of infecting the whole field. When these zoospores, as they are called, have been dispersed in that way, after a time they come to rest, they lose their whip-lash filaments, and they then eventually germinate. This process of germination consists in the protrusion from their substance of a small process which punctures the tissues of the potato plant, feeds upon them, takes nutriment from them, and then extends through the tissues of the potato plant by continued growth and branching a number of filaments which, as I began by saying, break down the continuity of the tissues and produce decay and death in every part that they traverse; so producing the well known effects which a field of diseased potatoes exhibits. Well, that is the rough outline of what happens when an outbreak of potato disease takes place. Of course the scientific history of this subject, and the economic importance of the matter, is not exhausted by that statement. There appears no reason to believe (and I say this, of course, subject to correction) that these ovoid bodies have more than a temporary existence; it is not, I believe, accepted that they are able to pass over a winter and so to be a source of infection by being dispersed in the soil, or in any matters connected with agriculture, so as to serve as the seeds of the fungus in the following season. I should just add to what I have said about these ovoid bodies (it is a matter of no very great importance, but it makes the statement that I have given more complete), that occasionally the contents do not divide; and in that case the whole ovoid body is susceptible of germinating or of throwing out a filament from it very much in the same way as an individual segment is. The question then arises in what mode is the continuity of the disease provided for by nature; in what way is the process of hybernation accomplished; how is the disease carried over from one year to another, and that, of course, is an economic problem which is of great importance, because if we could wipe out the disease after it has done its worst in one year, we should, of course, be able to start afresh in another year, and the potato disease might in that way disappear from agriculture. I have said that there is apparently no reason to suppose that these ovoid bodies, the history of which I have described, have more than a temporary function to serve; but they are the undoubted mode in which the fungus is dispersed during the season of its appearance, whether by mechanical means or by currents of air, and as its growth and multiplication proceed with extreme rapidity, as soon as these ovoid bodies have been dispersed and discharged their contents, they soon give rise to a new crop of spores, and so on, *ad infinitum*. The rapidity with which a field is attacked from perhaps only one centre is a matter which need not be wondered at, because the infection is carried on with very great speed indeed. Well, there are two points from which what is called the hybernation of the disease has been regarded. I should say that fungi of this description are very well known to scientific men. There are many species very closely allied to that which attacks the potato plants, which are common on many of our British weeds; and it is a remarkable thing that the biography of some of these unimportant species is much better and more accurately ascertained than that of this serious one which we are now considering. In the case of some less important species allied to the fungus of the potato disease, there is another kind of reproductive body which is occasionally met with. I will not trouble the Committee with technicalities, but such a body I may state is called a resting spore, and it is produced by what is essentially a sexual process; that is to say, two parts of a filament of the potato fungus contribute towards its formation, one being the receptive organ, which outlines or forms the spore, and the other supplying the fertilising influence which is necessary to its future vitality.

The

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The body so formed is called, as I have said, a resting spore, and it differs from the ovoid bodies I have described in not being adapted to a mere transitory purpose, but having considerable powers of dormant vitality, having considerable powers, in fact, of existing through the winter, so that in the case of some of the resting spores of some other species they are found in the soil, and can occasionally actually be detected there, and there is no doubt that just like the seeds of weeds, they fall into the ground, lie dormant during the winter, and then when the warm wet weather comes are ready to spring into vitality. Theoretical considerations would lend one to suppose that such a resting spore would be detected in the case of the potato fungus, and the scientific men of Europe, of this country and elsewhere, have had their attention very anxiously directed towards that point. It is a point to which Mr. Carruthers has paid more practical attention than I have, and we may or may not agree with what seems to me to be the balance of evidence upon this matter. Mr. Worthington Smith, whose name will possibly come before the Committee, believed that he had found such bodies, and it is by no means certain that his discovery is not a genuine one. The evidence is not absolutely conclusive, although it affords a high degree of probability. But I think it may be stated with some degree of certainty that whether these resting spores exist in the case of the potato fungus or no they are comparatively rare bodies, and it is not by means of them (of course I say this entirely on my own responsibility), that I think the potato fungus is perpetuated from year to year, at any rate, in the vast majority of cases. I have read the researches which have been made by several persons, and which have been most carefully conducted by Professor De Bary, whose name I have already mentioned, and who is the greatest living authority for this group of plants. His observations convey to my mind a very strong feeling of probability that the mode in which this potato fungus is carried on from one year to another is by means of filaments of the fungus, which apparently pass into a dormant condition in the tubers in the seed potato. After the fungus has attacked the foliage in the way I have described, there is little doubt that as all the succulent tissues of the potato are susceptible of giving it nourishment, it not only devastates the foliage, but finds its way down the baulm or the stems of the potato plant, to the tubers, these being only a modification of the haulm, and in direct communication with it. I have little doubt, in fact, that the potato disease is perpetuated by the mycelium, as it is called, that is to say, by the filaments of which the potato fungus is made up.

Mr. *Tottenham.*

4. Would your theory be, then, that the disease invariably commences in the leaf or in the stem of the plant?—No, I only started with that point, as I began by saying, as a convenient point of departure. I was going to deal with that question after having in the first place discussed the outbreak of the disease, as it attracts the attention of the observer in the autumn. I was then going to consider how it passes through the winter, and finally how it began again in the following year; that, I think, will meet your point. I have no doubt, then, as obviously must be the case, otherwise there would be no potato disease to discuss in an economic sense, that the tubers are affected, and when the temperature of the year falls, I can quite conceive that the mycelium loses its vitality, and remains in some, at least, of the tubers without carrying on the work of feeding upon them and destroying them with any very great degree of rapidity, so that it is quite possible that apparently healthy tubers may be harvested, which still contain some dormant portion of the mycelium of the fungus. When the potatoes are stored, as is very often the case in some kind of pit, they are accumulated together, and it is quite conceivable, and I believe it occasionally happens, that there is some rise of temperature under those conditions. Such rise of temperature would undoubtedly start the dormant mycelium on its career again, and it would begin to feed upon the potatoes and destroy them. It might even under those circumstances, though I have nothing but hearsay evidence upon the point, hearsay scientific evidence, that is to say, it might even then produce the ovoid bodies which set free zoospores. These ovoid bodies might become attached to apparently quite healthy tubers, and these tubers might be used for sets in the following spring; and so tubers which are quite healthy, and yet practically were infected, might, with all the care in the world, be planted by husbandmen, and so give rise to a fresh outbreak of the disease. No doubt when that takes place the disease begins to show itself in the spring, and it is quite certain from experiments that have been made, that where inoculation has been effected in that kind of way, the disease takes some time to develope itself. The young shoots of the potato are gradually infected, though somewhat slowly, and especially if a dry season occurs early in the summer, the fungus is struggling against great disadvantage, and may practically be stamped out, or may only just maintain its life. Then when you come to the late summer, and you get warm rain, as is sometimes the case, that is a condition which is highly favourable to what one may call the intense vitality of the fungus. It then makes an appearance on the foliage of the potato plant, develops the reproductive ovoid bodies, and, having once done that, its dispersion over the rest of the field is a question of a very short time. That I think covers all the ground which it seems to me important to suggest to the Committee. Of course it is a sketch which in a scientific sense is in many respects a very imperfect one, but I do not know that I have omitted, as far as I can remember, anything which strikes me as being really essential.

Chairman.

5. Are these ovoid spores that you have spoken of the same as the zoospores you spoke of?—I spoke of an ovoid body, so as to not use more technical expressions than I could help, and the zoospores are the motile contents of those ovoid bodies.

6. Then during the summer you consider the disease is propagated exclusively by these ovoid spores and by the zoospores?—I do.

7. Exclusively during the summer?—Yes.

8. Can you say how soon after the spores fall upon the potato plant, that they reproduce fresh spores, so as to carry on the disease afresh?—I cannot say with absolute certainty, but my impression

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pression is that two days would be a probable period.

9. How far can these spores, do you believe, be carried by the wind?—I am extremely doubtful whether they are carried to any great distances by the wind; that is to say, I am quite sure that the zoospores cannot be carried by the wind. These ovoid bodies might conceivably be carried by the wind; but I extremely doubt, seeing how very necessary moisture is to their vitality, that they can be carried far in that way.

10. Do you think they cannot be carried very far?—I do.

11. Then in that case, would not the potatoes be comparatively safe, planted from healthy seed, if there were no diseased potatoes, say within a mile of them?—Yes; if you could guarantee the seed being healthy.

12. If the seed was healthy?—Yes, but as far as I know, as long as the potato has ever been in cultivation, I do not know whether there is any evidence that it has been ever free from the potato disease. It is stated by Boussingault, the French chemist who has lived in South America, and who is a very eminent authority, that in Western South America, which is the native home of the potato plant, it always is diseased more or less. Therefore I apprehend that the potato when it was first introduced into this country had more or less the disease hanging about it.

13. Then do you believe the potato disease was in this country before 1844 or 1845?—I have no evidence which would make it improbable, but I have also no evidence that it was so.

14. Do not you believe, then, that the potato disease was a wave that came from South America, through North America, to this country, about the year 1845?—I know of no evidence to point to that conclusion; I should rather apprehend the facts were somewhat against it. It began seriously to attract the attention of farmers, I think, about the year 1842, in which year it appeared in the province of Liège in Belgium. In the course of the year 1845, the epidemic had made its appearance first in Belgium, and then in the South of England. In the previous year it had been very prevalent in Canada and in the north of the United States. I really have not made up my mind so as to speak with accuracy on the subject; but I am inclined to think that these facts are not incompatible with the potato disease having been in a somewhat inactive and struggling condition in all the countries in which it was subsequently a serious epidemic.

15. Did the virulent type of the disease come from America in the year 1844-45?—I am extremely doubtful; I have not sufficient evidence to enable me to speak positively about it, but I should be inclined to think that the epidemic of 1845 was due to the occurrence of climatic conditions, which gave the potato disease such a chance as it never had had before. I have not prepared myself with regard to the climatic conditions of 1845, so that I am not able to speak positively upon the subject; but that is the way in which it presents itself to my mind.

16. Then you believe that if there was healthy seed planted, say within a mile of potatoes that had the disease, very probably these potatoes would escape, and there would be a very small chance of their being reached?—It is extremely difficult to say. I mean the operations of agriculture involve a certain amount of movement, of course, from place to place, and it seems to me that, apart from the action of wind, unless one could isolate the healthy seed in a very absolute manner, and prevent the farm labourers passing from one field to another, that it would be extremely unlikely that the healthy seed would escape, because I apprehend that, although I am indisposed to believe that the wind is a mode of conveying the infection over a considerable distance, I see no reason to suppose that the movements of farm labourers, the transfer of manure, the mere use of implements in one field after they had been used in another, might not be a mode of conveying the spores in sufficiently quick time to enable them to maintain their vitality. In that kind of way I should imagine the infection would be dispersed, merely judging from analogy.

17. Then your evidence goes to this: that the communication is through the seed, and not through the atmosphere?—Certainly. As far as I have studied the subject, my mind certainly tends to the conclusion that it is practically impossible to obtain the seed of potatoes susceptible to disease entirely free from all contamination. That appears to me to be a sufficient explanation for the carrying on of the disease from one year to the other.

Sir *Edmund Filmer*.

18. Do I understand you to say that there is no seed free from disease?—I could not, of course, absolutely say that, but only so far as the ordinary kind of potatoes only that are cultivated. This touches on another matter, which I might afterwards be allowed to allude to. Supposing that potatoes which suffer from the disease continue to be cultivated, then I should apprehend that the process of cleansing them from the disease would be practically a hopeless one.

19. That is to say, there is disease in all potatoes?—There is disease more or less.

Chairman.

20. You do not believe that these ovoid spores can last through the winter?—No.

21. Then, if there were such things as resting spores, which, I think you said, were discovered by Mr. Worthington Smith?—Yes; still, of course, scientific men can hardly be said to have made up their minds completely upon the subject of these resting spores, but Professor De Bary, although not absolutely convinced, thinks it not at all improbable that they are the real thing. He adds that if they are the real thing they are very rare, therefore, for the practical purposes of this Committee, it strikes me that their study is not a very promising line of investigation.

22. You attach very little importance to resting spores if they do exist?—As I am at present advised I attach very little importance.

23. The only thing that could remain in the ground with vitality would be these resting spores, if they did exist?—Yes.

24. If the same ground is not planted a second year in succession with potatoes, there is very little chance of communicating the disease from the ground?—Precisely. Of course I ought to add (Mr. Carruthers will give more information upon the subject than I can) that there is a branch of inquiry which has been pursued with some interest, though, at present, with entirely negative results, which had for its object the

detection

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detection of the resting spores upon some other plants. It is not an uncommon phenomenon amongst fungi, that they pass one period of their lives on one plant, and another period on another. The case of rust in wheat is a well-known example, but I believe that line of inquiry has not been fertile in regard to the potato fungus. It was thought, for example, that a crop like clover might carry on the disease; but I am inclined to think (though of course that is only my own opinion) that the evidence is rather against that being the case.

25. There is, generally, more disease after clover, for some reason, is there not, than after other crops?—That I cannot speak to.

26. I thought there were some experiments to that effect?—It probably is so, because clover has been suspected as one of the hosts of the potato plant.

27. You are, probably, of opinion, then, that the disease cannot flourish or propagate itself except in connection with potatoes on other plants?—That, of course, is another matter.

28. It does attack some other plant?—Yes; but I believe to no appreciable extent; for instance, I have seen myself, on the last serious outbreak of the disease, the tomato plant attacked by the potato disease, from potatoes growing in a garden. It must be remembered that the potato belongs to the same botanical genus as the tomato.

Mr. *Earp*.

29. Reaching the fruit?—That I am not quite sure about, but it killed the tomatoes, so that I think the fruit did not come into question. Then it will also attack our *Solanum Dulcamara*, the bitter-sweet of the hedge-rows, and it has affected a few other plants; but that line of inquiry has not led to any useful result.

Chairman.

30. You do not think the attacks on other plants propagate the disease, or carry it on from year to year?—No, I do not.

31. Does the disease remain at all in the stalks from one year to another; do you think the stalks can possibly carry the disease, the spores, I may say, from one year to the other?—I apprehend that, inasmuch as I have no doubt the tubers carry on the mycelium from one year to another, there is no improbability in the stalks doing so. The objection which occurs to my mind is this: the stalks, of course, are not so dense and firm as the tuber, and when the stalks and the foliage are attacked by the disease, they generally become rotten so rapidly from the breaking down of the tissues which the mycelium produces, that no one would think of hoarding them up.

32. If the stalks were thrown on to the dung-heap, and that manure was afterwards used to manure the potato crop, do you think that would be the means of carrying on the potato disease from one year to the other?—It is difficult to say. It would very much depend upon the amount of decomposition to which they were subjected. The potato fungus is very rapidly destroyed by the decomposition of the tissues in which it lives, so that if the dung-heap were thoroughly rotted, I should doubt whether there would be any material risk from that mode of infection; but I think a prudent husbandman would prefer not to strain a scientific point, and would destroy the refuse of the potato fields by fire.

33. Then you think, if a potato field was badly diseased, or half the potatoes destroyed, it would be advisable to burn the stalks in the autumn, instead of putting them on the manure heap?—I should think so, certainly; it is better to be on the safe side.

34. Do you think it would tend to limit the attacks of the disease if the stalks were burned?—That is going rather farther; I say I would merely have them burned as a matter of precaution, whether I believe it is very important or not, simply to lessen the chance.

35. You could not say positively it would have no useful effect?—No, I could not.

36. Then your own idea seems to point to this, that practically the disease is carried on from one year to another entirely through the tubers of the potatoes themselves?—Yes.

37. How is that affected when potatoes are stored; is the disease propagated from one potato to another when they are stored in outhouses or in pits. Those are the ways in which I understand they are stored?—Well, I believe, as I have said, that when potatoes are accumulated together, if there is a slight rise of temperature, there is nothing to prevent the potato fungus beginning to grow in these accumulations. I think the experiment has actually been made, and the potato fungus under such circumstances has produced spores, and these spores may of course inoculate perfectly healthy potatoes, free from the disease.

38. What would you call a rise of temperature in days of December or January in an ordinary winter?—I must not travel beyond my *métier*; what I mean by rise in temperature is this: it is very common when fresh vegetable matters are heaped together that there is a slight rise of temperature from what is called heating. If you put a quantity of cut flowers in a box, there is a rise of temperature simply from the oxidation of the dead organic matter, and if that happened in a potato pit, such a rise of temperature would be calculated to start the disease.

39. Do you consider practically that such a rise of temperature would take place in an ordinary potato pit?—Yes, I think it may under such circumstances.

40. And you think it does practically often take place?—I think so.

41. If the potatoes were brought into an ordinary house, would the temperature there be sufficient to propagate the disease in many cases?—Yes, I think it might be.

42. And do you think it would be much better to have potatoes stored in an outhouse than in a house where there was fire?—I certainly think it would check contamination if the place where they were stored were kept as airy and well ventilated and as cool as possible (short of a freezing temperature), so as to reduce the temperature; but still that after all would not affect the case of potatoes which were stored with the dormant mycelium in them which may be used as sets next year, and so start a fresh outbreak. What impresses my mind very strongly indeed with the difficulty of dealing with this matter, is the very small amount of contagion which is sufficient to do all the mischief. As far as I can judge from the facts, it

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seems to me that one diseased potato in an acre is quite sufficient to ruin the crop.

43. If the weather is favourable in the autumn for the rapid spread of the zoospores as fast as they are formed, I believe the diseased potato will gradually produce fresh potatoes; it will not die; it will sometimes grow fresh potatoes?—Yes, certainly. A remarkable thing is that a diseased tuber from its eyes will in some cases produce a perfectly healthy foliage, and give rise to perfectly healthy tubers; that is a natural provision which is in favour of an immunity from the disease. If every diseased potato did its very worst, I do not know where we should be, but fortunately a certain number of diseased potatoes, regarded as starting points of the disease, are abortive in the way you have described.

44. Do you think it of very great consequence that the diseased potatoes should not be planted; potatoes that can be pointed to as actually diseased?—I think it is of the greatest importance not to plant them.

45. And if there have been any diseased potatoes in the crop from which the seed is produced, do you think the remaining potatoes ought to be looked upon with suspicion as seed?—Most decidedly.

46. Say a quarter of the crop was diseased, would they be unfit for seed?—I would not go so far as to say that, because everyone trusts to the chapter of accidents, and you might risk it and get a good crop. The disease is not very severe every year, but certainly if I were acting on my own responsibility I should feel a certain anxiety in the matter.

47. How does planting diseased potatoes, or potatoes that have been in contact with diseased potatoes, affect your neighbour's crops; does it make it more likely that his potatoes will be diseased. I mean if there are a dozen men in a village, and half of those plant diseased seed, and the other half healthy seed, are the men who plant healthy seed much affected by the others?—Certainly, because their own fields are liable to be infected. I have no doubt that one mode which operates in spreading the disease from one place to the other is the migration of ground game. A rabbit running through a district might infect every field it passes through. A field rat or a mouse would equally serve, its fur being imbued with dew or rain and the spores therefore adhering to it.

48. Are any varieties of the potato more disease proof than others?—Well, I believe that is undoubtedly the case, and it seems to me that it is in that direction in which we must hope that relief may ultimately be achieved. This is a subject on which, I think, Mr. Carruthers has made so careful a study, and has prepared so exhaustive a report, that it would be hardly proper for me to give evidence upon it, he can give it in so much more forcible a manner; but I may state what is the theoretical probability of the matter. Some years ago it was pointed out by Mr. Darwin that it is a remarkable thing that some cultivated plants are less susceptible to disease than others, and that is particularly the case with regard to the apple, which is subject to the American blight, which is not a plant, but an insect, and it is a very remarkable and significant thing that from some cause upon which no light, I believe, has been thrown, some kinds of apple enjoy a complete immunity from that parasite, which is most seriously destructive to others. There is one apple called the Winter Majatin; and a gentleman told me, who has seen a great deal of it, and made a very careful examination into it, Mr. Clarson, that besides that apple, the New England Pigeon, the Northern Spy, and the Duchesse D'Oldenburg, as well as some others, are not affected by the American blight. That is a very significant thing. If it is possible to have varieties of apples which enjoy immunity from a parasite which is most destructive to the vast majority of the cultivated sorts, there appears to be no theoretical improbability in our obtaining, thanks to the enormous variation which cultivation induces in plants, a variety of the potato which will, from some cause which it is hardly necessary even to investigate, enjoy an immunity from the ravages of this fungus. A variety of structural modifications might be suggested, but it is hardly necessary to trouble the Committee about them, of which the potato plant or its tubers might be susceptible, which would just make it impossible for the fungus to implant itself upon them; and, of course, if that could be attained, the thing would be only to cultivate disease-proof kinds.

49. You do not know of any late experiments in that direction, do you?—A certain number of kinds, on apparently rather slender grounds, were a good deal talked about as having some disease-proof properties, and Mr. Carruthers, of the Royal Agricultural Society, made a very careful series of experiments upon the merits of those kinds. I believe none of them really survived the ordeal, but the interesting and important fact did come out that undoubtedly some of them showed a tendency to be less susceptible to diseases in all parts of the country and in all kinds of soil than others Well, that was a most important step, undoubtedly. There are now two potatoes, I believe, one called the "Champion" and the other the "Magnum Bonum;" and I understand, as a matter of common repute, that these two kinds of potatoes, to a large extent, enjoy immunity from the disease.

50. Is the propagation of the potato from the tuber, from year to year, a natural mode of propagation in plants, or would you say that it might have some tendency to weaken the plant; I mean the present mode of propagating the potato?—I know that it has been held that what is called vegetative reproduction, that is to say, reproduction apart from the formation and sowing of seed, tends to weaken the constitution of the plant, but I do not myself think that the facts have been made out, and one could not have a better proof of that than the American weed which fills up our canals and navigable rivers, of which we have only one sex in this country, and which, therefore, can be demonstrated to have originated from one single piece, and yet it has spread all over the country. I have heard no facts to make me believe that it has lost its vegetative vigour, although it is, of course, propagated entirely without seed.

51. Is there any botanical reason to believe that potatoes which have been grown for 50 or 100 years from tubers without fresh recourse to seed may not be weakened in constitution?—I do not think there is, although I have no doubt the Committee might get botanists of repute to give them an opposite opinion. But simply offering them my own judgment, I see no reasons

why

Chairman—continued.

why the potatoes should be more susceptible to disease because they are propagated in that way.

52. Does the want of any element in the constitution of the potato, such as potash, have a tendency to increase the disease?—I think not. Of course my mind may be biassed upon that matter, but I am so firmly impressed with the belief that, given the potato fungus, the potato plants, whatever might be their other circumstances, would equally succumb, that I have not thought upon the matter from any other point of view. It appears to me that just in the same way as the most healthy person, if he is subjected to some virus, will succumb to it equally with the most weakly person, there is no practical relief likely to be got by considering the diminution or increase of vigour of the potato plant. I think, however vigorous it was, it would equally succumb to the disease if the spores were there to attack it.

Mr. *Tottenham.*

53. I should like to know whether those bodies that you spoke of in the leaves assume the same character in the tuber?—Well, I must explain. Those ovoid bodies are only produced on a free surface. The way in which the nature of the potato disease was first made out was this: the mould was observed upon the leaves; then it was ascertained to be the cause of the disease in the tuber by cutting a diseased tuber open, keeping it in a damp atmosphere under a bell glass, with a little water, and observing that the same mould made its appearance on the cut surface, so that practically wherever in the potato plant you have the mycelium this fructification may emerge from the surface, and it appears that experiment has shown that the mould may even come through the skin of the tuber, so that it may make its appearance on the outside of a tuber which has not been cut.

54. But when magnified would the appearance of the brown spot which is known in the tuber itself have the same appearance as is represented there; would the fungus be the same character which is represented on that diagram?—Yes.

55. Just as it appears on the leaf there?—Exactly. You may get a similar preparation from a tuber.

56. Is your theory, then, that the disease always commences with the leaf or with the stalk of the plant, and works downwards, or may it work upwards from the tuber?—The view I take, rightly or wrongly, is that it begins with the diseased set, that it then makes its way up; it probably in some cases grows with the shoots; as the shoots grow up they are always diseased from their infancy onwards, till at last when the plant is mature spores are produced, and are distributed. There are some facts which tend to show that the mature foliage of the potato lends itself more readily to the attacks of the disease than the young and growing foliage.

57. Is it not the fact that a plant which is apparently healthy over ground will never have diseased tubers?—Well, unless it were affected subterraneously; it has been suggested that the earth worm may carry the infection from one diseased tuber to another, but still I should say practically that, as one sees the disease in late summer, I should not apprehend that the tubers would be seriously diseased, or even appreciably diseased if the foliage appeared healthy.

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58. Do you believe in the spores living over the winter in the haulm?—Well, it is difficult to speak positively upon a point upon which one has no precise evidence, but I should say not.

59. Are not the conditions necessary to keep them alive the fresh tissues which would be in the haulm when sound?—I believe what would remain in the haulm would be the threads of mycelium, and my belief is that they would destroy the haulm and rot it, and destroy themselves in the process, so that I am disposed to think that the haulm is not an appreciable mode of carrying on the disease, though I am not prepared to say that under some circumstances it might not do so.

60. You think they can be maintained in the ground over the winter?—The resting spores?

61. Yes?—Undoubtedly; but what I said upon that is that the occurrence of the resting spores seems to be so rare that it hardly becomes a problem of practical importance to consider what part they play in the perpetuation of the disease.

62. You believe that a second crop of potatoes, succeeding one crop after another, would be more liable to the disease than if there had been an interval of two or three years between the crops?—No; I apprehend that it would not be, putting the question of the resting spores aside. Of course if their abundant occurrence is established, which is not the case at present, then undoubtedly, to plant a new crop in a field which had been the seat of a bad attack of the disease in the preceding year would be simply leading the crop to destruction; but, as I have at present been able to sum up the information that I have upon this point, I cannot say that I am satisfied that the resting spores play a very important part in the matter. Professor De Bary, certainly so far as I understand his opinions, is strongly of opinion that in Germany at any rate they do not.

63. Then an interval of two or three years would entirely obliterate any chance of the crop being infected from that source?—Yes, certainly.

64. Have you at all thought of the subject of how a thunderstorm or electrical disturbance affects the commencement of the disease in a field or a district?—I have not thought very much about it, but my own opinion is that electrical conditions have extremely little to do with vegetation; that it is the saturated state of the atmosphere which concurs with electrical discharge, which is the important thing; and the mere concurrence of thunder strikes me as a fact of no significance.

65. I have noticed myself that it is invariably after a thunderstorm that the disease first shows itself in a district?—Permit me to say that only suggests to my mind that it was after a fall of warm rain, and where you have two concurring things it is quite possible one may be active and the other ineffective. I think the thunder has no real connection with it.

66. You believe thunder has no connection with the disease?—I think not; we know of no facts which show that atmospheric electricity has any real control over vegetable growth. It may be so, but no facts have been ascertained to lead to that belief.

Mr. *Macdonald.*

67. May it not be that the electrical heat has produced that which you have stated, the wet conditions

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conditions necessary for the disease?—Heat undoubtedly is a necessary condition.

68. You say heat and rain?—Yes; warmth and moisture are the essential conditions.

69. And the electrical condition may really have not been the cause of that development of which you spoke?—No; that is to say, unaccompanied by a higher temperature and the deposition of moisture.

Mr. *Tottenham.*

70. Take the Champion potato, which you have named, is there any difference in the skin of that potato from others?—I do not know at all.

71. As a matter of fact it is very thick in the skin when it is boiled?—I should apprehend that if a potato, enjoying an immunity from the disease, is ultimately obtained it would exhibit some difference of structure to account for it. I may mention that a very serious disease is now attacking the coffee plant in India and Ceylon, that is, a fungus with some points of resemblance to the potato fungus. The coffee plant in the New World is attacked by a small moth which injures the leaves in very much the same way as the fungus. In both cases Liberian coffee, with very thick leathery leaves, enjoys immunity from these two parasites. That is another confirmation of the fact that if one could obtain some structural modification of the potato plant we may ultimately obtain plants which would not succumb to the disease.

Mr. *Earp.*

72. I think you have told us that the matured leaf was more susceptible than the young leaf of the potato plant?—I merely mentioned that. I think some facts leading to that conclusion have been ascertained, but I cannot speak from any positive knowledge about it.

73. Would it not seem that, at all events, the matured tuber is more likely to manifest the disease than in an earlier state of its growth, because we hear of the tuber disease in autumn?—That circumstance, as I understand the matter, seems to depend rather upon climatic conditions. I think Professor De Bary has mentioned that in the neighbourhood of Strasburg, where there are mountain valleys, in which rain occurs early in the summer, you get the potato disease earlier than is usually the case with us. It is the late summer rains which seem to give the fungus its opportunity.

74. Should not you, from the appearance there of what you may term a sort of efflorescence, the filaments of the elongated bodies (*pointing to the diagram*) correspond to a great degree with the manifestations of the yeast plant in its growth; should not you think it is the result of a sort of ferment?—I am afraid that would lead me to a longer scientific discussion than perhaps the Committee would quite care about.

75. Do not you think the secret of the whole matter lies somewhere in that direction?—You see the yeast plant is not what one would call a parasite at all.

76. The spores are not connected by filaments as in that case?—The yeast plant does not live on a living organism; it simply lives in a solution of sugar containing a certain amount of nitrogenous nutriment.

77. But must not that be the case in this plant when it is embodied in the tuber?—That is precisely true; but it feeds upon the tissues of another living plant, and it practically draws from that plant the materials for its food already made, whereas the yeast plant produces chemical changes of very great importance; I mean the production of alcohol. Its mode of nutrition, from a scientific point of view, is quite different from that of the potato parasite. I apprehend the parasite of the potato plant simply takes out the contents of the cells and turns them at once to its own ends.

Mr. *Macdonald.*

78. I think you said that the Magnum Bonum was a plant free from it, but you qualified that, and you said to a large extent free; have you known them to be attacked?—No; but what I meant was, that I have merely such hearsay evidence as comes to my knowledge. I do not wish to state anything with regard to that particular kind of potato of an absolute character. It has been merely mentioned to me in conversation, amongst people interested in the matter, as a potato which has the reputation of being disease proof.

79. It is not then from your own knowledge that you make the statement?—With regard to the Magnum Bonum, I have merely been told by persons, whose veracity I implicitly trust, that it had in their experience an immunity from the disease where other potatoes were attacked; how far that would be the case over a large area it would be perfectly impossible for me to say.

80. Then you know of no reason in the structure of the skin of the potato, or anything of that kind, why it should be so?—No; it appears to me to be a purely empirical result; I expect that if a disease-proof potato is discovered it will be in a more or less accidental manner, and will force itself into favour by demonstrating in practical agriculture the properties which are assumed for it. I am not at all sanguine that by any scientific experiment a disease-proof potato could be produced. I mean to say that if one cultivated potatoes on a very large scale and went on for some considerable time, one might, by very carefully selecting every year those potatoes which were least attacked, arrive at such a result; but it is a thing which I apprehend will take place as the result of private enterprise; it is everybody's interest, and everybody will seize upon every variety which shows the least disposition to development in that direction.

81. As to the development of the disease, do you think its development at a particular period is owing to climatic conditions rather than to any other cause, such as thunder, or anything of that kind?—I think that particular climatic conditions lend themselves to the extension of the disease; and I think it is probable that in every year it is to be found, but it is not every year which lends itself to that violent extension which produces the destruction of crops.

Mr. *Stewart.*

82. The reference to this Committee is an inquiry as to the best means of diminishing the frequency and the extent of failure of the potato crop; have you any general views to give the Committee on that particular subject?—No, I am afraid I have not; I should be sorry to say anything

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thing disrespectful to the deliberations of the Committee, but beyond collecting the views of practical and scientific men upon the matter, I do not think it is likely more would arise from its deliberations than would probably arise from the natural course of circumstances. I may say, as I said before, that the gradual selection of the disease-proof potato, which seems to me to be the way in which we may probably obtain relief, is likely to be produced by the mere operation of economic laws apart from any assistance on the part of the State.

83. I think I gathered from you that the way your mind inclined to view the case was this, that by very careful selection of the tubers to be planted by degrees you obtain a crop almost entirely free from disease?—That unfortunately arose from my using the word selection in a technical sense; I meant not the selection of tubers for the sake of obtaining a healthy crop, but the selection of any particular race of potato which showed immunity from the disease, and repeating that process from year to year in the same way that one selects animals for breeding.

84. According to the Darwinian theory?—Or natural selection, as it is called.

85. Is this potato disease the same in foreign as in home tubers; is it the same class of disease?—You mean would it be the same in America as in France?

86. Yes, and in England we will say?—Yes, the actual fungus which produces the disease is uniform all over the world, in Bogota, Canada, Belgium, or the South of France.

87. You dropped, in one of your answers, that the wheat-rust had a certain affinity, for certain plants could find a resting place upon them?—Yes, it is believed on very good grounds that it finds a resting place in the Barberry, which is sometimes present in the hedgerows of wheat-fields.

88. But it could not come to maturity or be thoroughly developed on these places?—Its life follows a cycle; it leads a certain portion of its life on the wheat plant, and then it is necessary that it should migrate to the Barberry and pass another portion of its life there, and then back to the wheat again in the same way as the fluke in sheep, and other parasites, pass portions of their lives in different animals.

89. Have any experiments been made to get a pure seed by only using the green berries of the potatoes; the fruit of the potato for seed?—From the actual seed as distinguished from the tubers?

90. Yes?—I believe such experiments have been made, though I cannot speak with perfect recollection on the subject. I think when I was in Ireland I heard such experiments had been tried, but that they had not led, as indeed I should expect, on *à priori* grounds, to any useful result, that the seedlings were just as liable to disease as any others. Sowing the seed is a recognised mode of obtaining new varieties; and if I were going to set about trying to get a disease-proof potato, that is one of the modes I should adopt: I should sow a great quantity of seed in order to get new varieties, and then see how they were attacked, and make my own selection. In that way raising potatoes from seed might lead to a useful result, but I do not think there is any difference of importance between raising potatoes from seed or from tubers.

Mr. *Stewart*—continued.

91. Did not raising potatoes from seed necessarily produce new varieties?—One constantly sees in horticultural catalogues, So-and-so's seedlings, which shows that it is one of the recognised methods of obtaining new varieties.

92. Has the effect of frost been proved to be unfavourable to this fungus?—Only in the way that reduction of the temperature is unfavourable to its growth.

93. Can any inexperienced persons detect the diseased part from the black spots indicated on the potato; is there any other mode?—I cannot say, but I have generally found, as a fact, that practical men get their eyes so well educated in these matters, that they are often better judges than scientific persons. They go entirely by indications which experience shows to justify certain conclusion; but I do not know I am sure what indications they would rely upon.

94. The black spots, I understand, indicate a certain progression of the disease in the first part?—Undoubtedly, the black spots in the tuber indicate that portion of the tuber which has been thoroughly penetrated with disease, and has become rotten in consequence of the passage of the mycelium through it.

95. But the mycelium is there?—Yes, and is making its way to fresh parts of the potato.

96. You have no other reason to give why the development of the disease usually takes place in the beginning of autumn in many parts of the country, apart from climatic causes?—No; of course, it takes a certain time to work its way up (assuming my theory is true) from the ground, but as I have already stated, if the climatic conditions were suitable for its development, the ravages of the disease might, of course, increase earlier in the year.

97. Do you know of any instances which prove that by cutting off the haulms on the first indications of the appearance of the disease on the tops of them, people have saved the tubers?—I have heard that such is the case. I know of no accurate information upon that matter. It all depends. It would be very difficult to lay down any general principle. If it was a comparatively early potato, and the tubers were mature, it would be a very good thing to do; but if it were a late potato, and the tubers were not sufficiently stored with starch, of course you would spoil your potatoes; they would be watery and worthless.

98. You would stop the growth?—I do not know that you would so much stop the growth as prevent the potatoes being fed from above. You would save your crop, but they would be comparatively worthless.

99. Have you heard of any experiments which have been made by dipping the potato in petroleum or other similar fluids as a preventive against insect life?—No, I have not.

100. You have heard of the experiments made with regard to sprinkling the ground with petroleum?—No, I have not.

Mr. *Round*.

101. I understand it is your opinion, that although the disease may show itself first in the leaf, it really proceeds from the tuber?—Yes, the point of infection of a field, I apprehend, proceeds from the tuber, although in the case of the infection being introduced from another field

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by the wind or the passage of any small animal, that principle would not apply.

102. Which side of the leaf will it show itself first?—Well, it produces a discolouration on the upper surface, and the fungus on the under surface.

103. The breeding spores would be on the under side?—Yes, the majority of them.

104. You say the Magnum Bonum is a potato, you hear, is most free from disease?—I have merely heard it amongst my friends. They have merely mentioned the names of the Magnum Bonum and the Champion as two potatoes which certainly seem to suffer less from disease than other potatoes grown in the same situation and at the same time. For instance, Kew, although of course a suburban neighbourhood, is a place where a certain number of potatoes are grown, and it is a matter of common conversation at Kew that the Champion potato has not suffered from the effects of the disease.

105. Not suffered at all?—As far as I remember, not at all. But then I mean to say, I do not attach to isolated observations of that kind any very great weight. I should be very sorry to do so.

106. I have here a letter from a gardener who grew 60 sorts of potatoes last year, and he only found one potato out of every bushel of Magnum Bonum diseased; would that be in accordance with your experience?—I really have not any facts about it. I think Mr. Carruthers would give the Committee much more accurate and first-hand information upon this point than I could, because he is in direct communication with the Agricultural Society, who have been making experiments upon that matter.

Mr. *Colman*.

107. Have you found or heard, as a matter of experience, that a potato which comes fresh from another district, will be good one year, and then in two or three years get subject to disease?—I am afraid that is rather a more practical matter than I am entitled to speak upon.

108. You have not had experience of practical potato growing?—No; I am not a practical agriculturist.

Mr. *Storer*.

109. I understood you to say, that your opinion, theoretically, was that the disease springs from the tuber alone?—Yes; that is the way the disease hybernates, and is transmitted from one year to another.

110. The potatoes grown from seed are equally disposed to the disease as those grown from tubers. How do you account for that?—Many people believe that the reproduction of the potato in the common way by sowing sets, tends to weaken the constitution of the plant, whereas if reproduction is effected by seed, the constitution is stronger. All I meant to say was that I am not aware of any facts which lead one to suppose that plants raised from actual seed are more capable of withstanding disease than plants raised from tubers. I do not think that is in conflict with the observation that the tuber was the place in which the fungus winters.

111. Do you think that the strong or enfeebled constitution of the plant makes any difference in the virulence of the disease?—No, I am inclined to think it does not. Whether the plant is weak or strong, it equally succumbs if the fungus gets hold of it.

Mr. *Barclay*.

112. To return to the subject of the propagation of the fungus, am I right in looking upon mycelium as corresponding with the seed of the fungus?—Mycelium is simply the technical word for the threads of which such a mould as the potato fungus is made up. The part of the fungus which traverses and destroys the potato tuber simply consists of branching threads. When I say threads, I mean that as a figure of speech. They are filaments, and to these filaments scientific people give the technical name of mycelium.

113. Then these filaments hibernate in the tuber all the winter, and probably grow with the growth of the potato, developing ultimately in the autumn, if the climatic influences are favourable?—I should entirely agree with that, except that, no doubt, they began to develope in spring.

114. I mean they develope very powerfully if the climatic influences are favourable, develope to the extent of being a disease of the plant in autumn if the climatic influences are favourable; but I understand you to suppose that it may probably be existing during the whole life of the plant?—Yes.

115. These filaments enter into the structure of the plants and they appear upon the lower part of the leaf under favourable climatic influences; that is taking the growth of the fungus from a different point of view from what you did to start with. Supposing that the disease is latent in the tuber, how does it manifest itself then as a disease which is evident to us commonly in a potato field?—I think it has been shown that the fungus will grow up from the eyes of the potato into the shoots, and as the shoots grow they are always diseased until they have attained a somewhat large development, and then the disease becomes itself reproductive and affects the adjoining healthy plants.

116. I understand you to say that this mycelium may be developed in a tuber during winter under favourable circumstances, that is to say that it lives upon the tuber?—What I said was that the mycelium may develope spores.

117. And may make progress in the tubers during winter, if the temperature of the potato happens to be raised to any considerable extent?—Well, it struck me that that was one cause which would facilitate the development of the reproductive bodies.

118. And seeing that the disease exists in the potato in its natural state, you do not have much hope that we may be able to get clear of the disease altogether in this country?—I do not myself think there is any chance of getting rid of the disease, except we could obtain a kind of potato which has a constitutional immunity from it.

119. At the same time I suppose you think that all precautions should be taken to prevent the propagation of the disease by means of filaments?—Yes; but, as far as I apprehend, I am disposed to doubt the practical possibility of success. I think, of course, that all reasonable precautions should be taken.

120. That is simply what I mean; whether they

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they would be successful or not is another question?—Certainly.

121. Practically, you would advise all farmers to take every kind of precaution against propagating the disease by means of sets?—Certainly, I would take every kind of precaution.

122. You would avoid planting as sets any tubers which had the appearance of disease?—I should sum it up in this way, that the cultivator should give himself every chance of getting a healthy crop, and therefore he should select the healthiest seed, burning all the diseased portions of the plant; that he should do, in fact, everything to keep the disease under. But I apprehended that my evidence was being taken from a strictly scientific point of view, and in dealing with the question whether by such means the disease could be exterminated, I think one is bound to say one is not very hopeful. Still any measure of success is of the greatest importance in a matter of this kind.

123. The Committee is rather appointed to get the practical results with regard to the best method of growing the potato, and keeping it free from disease; then I think your opinion, speaking from a scientific point of view and merely from theory, would be valuable as to such precautions as you judge from theory, might be advantageous in preventing the spread of the disease?—I should undoubtedly say that sufficient importance cannot be attached to the adoption of every measure which would limit or render ineffective the transmission of the disease.

124. Have you any suggestion that you could make as to any simple method of disinfecting potatoes as far as the skins are concerned, by killing any spores which might be adhering to the outside of otherwise healthy potatoes?—I am afraid offhand, I am hardly prepared to answer that question, although I think it is a matter well worthy of attention, and it would be quite easy to devise some method of performing such an operation.

125. To dry the potatoes in an oven to such an extent as would not kill the vitality of the plants, would that be likely to kill the germs of the disease?—I think it would be rather disadvantageous to the potatoes; I should prefer steeping them in some solution, such as a weak solution of sulphurous acid or of carbolic acid, or some solution which would kill the mycelium, or the spores if they were outside the potato; of course you cannot do anything to the inside of the potato without killing the potato itself; but as far as there may be any contamination on the outside I certainly think some mode of steeping them would not be without its value.

126. You would not have very much hope from experiments specially made for the purpose of discovering a disease-proof potato?—No, my opinion on that point is very clear. I think, as I said before, that it being everyone's interest to get hold of a disease-proof potato, if such a thing can be produced, it will be produced in accordance with ordinary economical laws. I mean I do not think it is a matter to which the State should be called upon to give any assistance.

127. What I was driving at was this, that the discovery would be very possibly more in the nature of an accident than by experiments on the part of the State with the special view or object of discovering a disease-proof potato?—Yes; it is quite true that such a thing would be, to a certain extent, an accident, but then it would be an accident which would be expected, and would be looked for; just as the production of any new kind of rose is an accident, but it is an accident which is sought for in a recognised and systematic manner. I mean the large seedsmen, to whom this matter is of great importance, would do their best to select from their seed farms any variety of potato which showed any prospect of being useful in that direction; but the experiment would be made by commercial men without the State interfering.

128. Scientific men would not predicate the conditions under which the experiments should be carried out from which you could have any hope of producing this disease-proof potato if such a thing is producible?—I do not think, in the present state of our knowledge, we could in the least.

129. You said you supposed that the slight heat which is usual in heaps of potatoes which are put together in autumn, before they are thoroughly dried, would be very likely to cause the development of the mycelium to go on in the tubers?—Yes.

130. It would be then, one great object, to prevent the spread of the disease, that the potato should be thoroughly dried, or that any rise of temperature should be prevented by ventilation?—Certainly; I think that is a very important point, and that housing of the potatoes should be made in receptacles as well ventilated as possible. The great point would be to supply the two conditions which are unfavourable to the development of fungi, namely, freedom from heat and moisture. Therefore if you keep the potatoes dry, and at a low temperature, you so far impede the development of the fungus.

Mr. *Macdonald.*

131. Considering the food of the people depends so much on the health of the potato, do you think there would be anything wrong in the Government establishing, in some of their great gardening establishments such as Kew, or by the aid of some of their officers, such a means as would enable them to discover a potato free from disease rather than leaving it to the economic laws of which you spoke some time ago?—That of course opens up rather a large question. In the first place, even if such a thing were desirable, Kew would not be available for such a purpose, because what would really be wanted would be a large farm. The whole question of how far the Government should lend any aid to agricultural experiments of course is a considerable one, and has always been tacitly settled in this country in the negative. I believe there is no Government establishment of any sort in the British islands where agricultural experiments at the expense of the State are carried out; so that I mean to say, to make experiments with regard to the potatoes would practically entail the question of a new department. In France, no doubt, such a thing would be done at once, but in England things are done in a different way, and there is, as far as I know, no institution available except, perhaps, the Albert Institute at Glasnevin.

132. If not available, do not you think that it would be highly desirable that such a thing should be done in some way?—I am inclined to think, that

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that if you have a number of public spirited men (I mean men of large capital and energetic habits), like our seed merchants, that they are practically making these experiments for you, and that the Government undertaking them, would be simply one more body engaged upon it. Then there is the theoretical objection that, practically, the Government never does these things with such energy as people who get a living by it. Of course, if a private individual were to discover such a potato as you have described, he would get a very large return for his discovery, and therefore he would be much more liable to be strenuous in the matter than a Government department.

133. Are you aware that they do that in America?—In America a great deal is undoubtedly done, especially by the Legislatures of the different States.

Mr. *Macartney.*

134. Has there been any potato yet found invulnerable to the disease, after being exposed for a certain number of years to the same climatic influences and temperature?—That is a matter upon which the Committee will have better evidence than I can give it.

Mr. *Earp.*

135. May I ask you whether you are aware of the practice which exists amongst certain small growers of dividing the sets, cutting them in certain parts, and so planting the various sets in order to multiply the produce?—Yes, I know that such a practice is followed.

136. Do you consider that detrimental?—You mean with regard to the disease?

Mr. *Earp*—continued.

137. Yes; but before asking you to answer me that, may I ask you will the filaments connecting the potato with its parent plant, be the channel through which the disease has reached the tuber?—I apprehend so.

138. Then small as that filament may be, it would contain still smaller filaments, which connects the disease, which forms the chain?—Oh, certainly, plenty of it.

139. In that case, if it be the ordinary practice to cut the sets, it would always be advisable to so divide them as to try to cut out the disease by taking, for instance, the top part of the potato where the filament had existed which connected the tuber with its plant?—Yes; but if you attempt to cut a set from a diseased potato, the chances are a thousand to one against cutting a set (at least, I mean against the ordinary cultivator doing so) which would be absolutely free from mycelium.

140. That is to say, the disease might have penetrated into the potato farther than the naked eye could follow it?—I think so.

141. Then are you of opinion that the practice of so cutting sets is very prejudicial?—Well, it only occurs to me at the moment that it might be prejudicial in this way. Professor De Bary has suggested that even earthworms might convey the infection. Well, undoubtedly, where you have the cut surface of the potato, it is more susceptible to infection than the natural skin, because the natural skin is obviously less easily penetrable than the succulent tissue of the potato, which is exposed when you cut it.

142. Then it would be advisable, you think, not to pursue that practice?—Well, I should be rather unwilling to pronounce a definite opinion upon it without further information.

Mr. William Carruthers, F.R.S., called in; and Examined.

Mr. *Carruthers*, F.R.S.

Chairman.

143. You are the head of the Botanical Department of the British Museum?—Yes.

144. You have specially turned your attention to potatoes?—Yes, in connection with the Agricultural Society, for which Society I have for many years been consulting naturalist.

145. You have written several pamphlets on this subject?—Yes.

146. We should be very much obliged to you now if you would make us a short statement about the potato disease, and if there is any point of difference between you and your friend; it is possible there may be different schools and different opinions upon this question. I hope you will give us any points upon which you differ, as well as those upon which you agree, because, of course, as far as scientific evidence is concerned, it is extremely necessary that we should know where scientific men disagree, as well as where they agree?—I may say that in regard to the account which Mr. Dyer has given of the fungus causing the potato disease, I entirely agree with him. There is no difference of opinion. This is not a theory which is held by scientific men, but the result of observation of facts, and there can be no difference of opinion at all as to the plant being the cause of the disease; and the whole story of the plant, which Mr. Dyer has put, is precisely what is accepted

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as the life-history of this plant. I do not know that I have anything to supplement to that. Of course it is necessary to make it somewhat popular here, and I think Mr. Dyer has given a very satisfactory account of the life-history of this plant. I differ however with him with regard to the origin of this disease, and if you will allow me I will put it to you somewhat historically. The disease, I believe, did not exist at all in Europe before 1844. In that I entirely differ from Mr. Dyer. Many diseases had been observed; many injuries to potatoes had been observed and carefully described before 1844, but this particular disease had not. It is due to a species of plant, and although that species is small it is as easily separated from allied plants as species of flowering plants can be separated from each other. This plant was known in South America before it made its appearance in this country. It has been traced from South America to North America and to Australia, and it made its first appearance in Europe in Belgium in 1844, and within a very few days after it appeared in Belgium it was noticed in the Isle of Wight, and then within almost a few hours after that it spread over the whole of the South of England and over Scotland. What is of very great importance for us to consider is that this was not at all due to the

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the presence of diseased tubers. The disease first made its appearance in Britain from some cause entirely outside diseased tubers, because in the planting of the crop of 1844 no diseased tubers were planted. I believe that the spread of the disease each year is due entirely to the same cause as its spread when it made its first appearance. The great difficulty in regard to the disease is what Mr. Dyer has again and again expressed, the method of its being carried over from one year to another. The appearance of the disease in the autumn, I believe, can be very easily explained. Mr. Dyer has shown that when the disease begins to make its appearance the fungus produces these large oblong bodies, (*conidia*), and the question is how these bodies are spread and the disease scattered. Now I differ from Mr. Dyer in this: I believe that these bodies which are produced in immense quantities, and very speedily, within a few hours after the disease attacks the potato, are floated in the atmosphere, and are easily transplanted by the wind all over the country. I believe this is the explanation of the spread of the disease in 1844, when it made its appearance in Belgium. The spores produced in myriads, were brought over in the wind, and first attacked the potato crops in the Isle of Wight, and then spread over the south of England. The course of the disease is clearly traced from the south of England towards the Midland Counties, and all over the island and into Scotland and Ireland. It was a progress northwards. Then the story of their growth is very simple This plant, the *Peronospora infestans*, will only grow on the particular plant, the *Solanum tuberos*, that is the cultivated potato. As Mr. Dyer has said, it has been noticed on some other plants, but it takes to those plants not kindly. It grows on this particular species, and just as plants of higher organisation choose their soils, some growing in the water and some on land, so this particular plant chooses its host plant; and its soil is this species *Solanum tuberosum*. It will not grow if it falls on the leaves of the beech or the oak, or on grass, because that is not its soil, so to speak. Now the process of growth is simply this: when this compound body falls on the leaf it will remain there perfectly innocent and harmless unless it gets a supply of moisture to enable it to germinate; just as wheat lies in the granary from year to year, and does not germinate unless it gets moisture. The belief which was expressed by a Member of this Committee that it was due to electric or other conditions, is very easily explained. The disease makes its appearance in the end of July or the beginning of August, when we have generally very hot weather. The temperature of the atmosphere is very high, and we have heavy showers of rain. Those showers of rain are generally due to electric disturbances; that is to say, are thunder showers; and the atmosphere, which is able in its hot state to take a large quantity of moisture into its composition without being seen, at night when the temperature decreases slightly by the disappearance of the sun, and the atmosphere loses some of its heat, then the moisture which was present, though imperceptible, in the composition of the atmosphere, gets liberated, and appears as a fog or mist, and this fog or mist supplies this compound body with sufficient moisture to disrupt it. The contents (zoospores) are liberated, and move about in the moisture for a little time till their tails disappear, and then they begin to germinate; they throw out a small root, which is able either to pass in through the breathing-pores of the potato, or to penetrate the skin of the potato, and as soon as it has got through the skin of the potato it pushes itself into the living tissues of the plant. It gets sufficient food there, and spreads freely all through the plant. The first appearance is the brown discoloured spot; then this brown spot sends out from the under surface a quantity of flocculent branches having the appearance to the naked eye of an ordinary mould, and when that disappears the spot becomes black, but the mycelium pushes its way centrifugally from the point of attack, and the mould spreads with the spread of the mycelium in the leaf, and you get a border of mould round the black spot, which gradually increase till it covers the whole of the leaf, and the leaf is destroyed. In the meantime the mycelium has been pushing its way down the stalk of the leaf, and down the stalk of the potato into the tubers in the ground; this, I believe, is the ordinary and normal spread of the disease, and it is not due to atmospheric conditions, except that it is necessary that there should be a supply of moisture outside the potato to enable the compound body to break up, and the little seeds to germinate; then when they take possession of the potato plant it is impossible to stop the disease, and when once it has taken possession of a single plant of potato, the compound bodies at the ends of the branches are produced in such abundance that clouds of them are scattered through the air, and are ready to attack not only the plants in that field, but the whole of the plants of the country, you cannot possibly stop it. I believe this is the story of the introduction of the disease in 1844 into England, Scotland, and Ireland, and is the story of the introduction of the disease every autumn. Of course the difficulty with regard to the disease is how it is carried over the winter; and if I may be allowed perhaps somewhat to repeat what Mr. Dyer has said, I would put it in this way, that it is possible that the plan which Mr. Dyer believes to be the main method, is one of the methods by which the disease is carried over; that is, it is carried over in diseased tubers which are planted; but if there is any reason to believe that Mr. Smith has found the resting spores, and I think there is some reason to believe that, then these resting spores are more probably the means of carrying the disease over. The resting spores are very different from the spores we have been looking at here. They have a very much indurated coat, which permits their preservation even in the most unfavourable conditions throughout the winter, and I believe that these resting spores are produced in the solid substance of the potato; they are in the leaf, the haulm, or the tuber, and are able to resist the decay which takes place in the leaf, the haulm, and the tuber; and they are carried over in this decaying matter through the winter, and are ready to operate when the season comes round for their germination. I do not believe that any amount of decay, even on the dungheap, would destroy these resting spores, if they are really the resting spores of the *Peronospora* that have been discovered. I have always recommended that the haulms of diseased crops should invariably be burnt in the autumn when the potatoes are

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are lifted, and should never, under any consideration, be put on the dungheap. I believe that that is a most dangerous method of spreading the disease, and probably is the method by which the disease is spread. But then Mr. Dyer also referred to the fact, that the lower fungi do not always pass the whole of their existence on the same kind of plant, and this is a matter which has never been fully investigated. Mr. Jenkins, the Secretary of the Royal Agricultural Society, drew special attention to information which he had received from farmers, that potatoes following clover had on some occasions been singularly free from the potato disease; but I must say that my own observations, when I carefully attended to this matter, did not substantiate that opinion. I have not been able to see any foundation whatever for supposing that any of our cultivated crops are the means of carrying over this fungus in another stage of its life. I believe that the disease is spread by these oblong bodies (*conidia*), and only through the leaves, and that this being so, I am not aware of any experiments, and I myself have failed in any experiments I have made to trace the progress of the disease from a planted tuber. I believe, however, the tubers may be the means of producing disease in this way. We know quite well that when potatoes are stored up in pits the disease increases in the tubers, and that the fungus grows in the pit, and I have no doubt this is due to the increased temperature which always takes place in pits, especially in connection with decaying matter. There is generally some straw put with them to keep them separate from each other. The haulms used to be put in in my younger days before the disease had appeared, and whenever this decaying matter is present a certain amount of decomposition, as in a dungheap, takes place. Under these circumstances the disease spreads in the tuber, and the resting spores would be freely produced in the tuber, so that you would have a condition eminently fitted for the production of these resting spores, and for the spreading of the disease. I do not know that there is anything more that I can say.

147. There are several important points on which you agree perfectly, about the botanical part; but not about the spread of the disease. Now about the wind, you are convinced that this disease can be, and is, spread very often by the wind?—I mean not by the wind as distinguished from the atmosphere, but simply by the atmosphere.

148. Then does it make much difference whether there are diseased potatoes immediately near a village, or will the disease find its way for miles off?—My belief is, that if a diseased plant were growing in the Isle of Wight the likelihood is that the whole of the crop throughout the three kingdoms would be, not destroyed but affected by it; that you could not possibly save it, and this is the case in other similar diseases. If you have a condition fit for the growth of mould of cheese or any decaying matter, you will find spores present in the atmosphere ready to take advantage of this condition of things, and the mould will at once make its appearance, and so it is with this mould of the potato.

149. Then do you think it is of much importance whether there is a large stock of diseased potatoes left over from the winter, or only a very small stock left in the kingdom. Do you think a few potatoes will be equally capable of affecting it in the same time?—Yes, I think the few potatoes will do it if the disease appears. Our difficulty at present is where the disease does appear, how is the disease carried over the winter? Granting the appearance of the disease in a field of potatoes in a county or country, you cannot stop its progress after the disease has appeared, but we do not know how it appears. That is the question the Royal Agricultural Society and botanists have been facing for years. They want to discover how it is that the disease in the first instance appears. Mr. Dyer has given you one explanation. It is not satisfactory to me. It may be the right explanation, but I am not satisfied at all that it is the right explanation; and what I do not see any light on at present is, how does this disease at first appears; does it come from these resting spores; does it come from other plants upon which this *Peronospora* lives in some forms not yet detected as belonging to it? Where does it come from? We do not know.

150. Then you attach, practically, great importance to burning the stalks of the potato plants from year to year?—Yes, I should recommend that should be done as a precaution to prevent the unnecessary spread of the disease, for the fire would destroy the resting spores if they exist in the haulms.

151. But do you think it will reduce the total amount of diseased potatoes in the year?—No, I do not think it will. In the visit that I made in 1874 the Royal Agricultural Society then offered prizes for disease-proof potatoes, and some six or eight specimens were sent in which were supposed to be, and believed by their owners to be, disease proof. Those potatoes were planted in 20 different localities over the three kingdoms, and during the end of July and the beginning of August I visited the whole of those crops. At the beginning of my visit I found no disease whatever in the South of England. I first noticed the disease in the South of Ireland, and as I went on my visits I found the disease rapidly spreading and preceding me in every direction, and at every place thereafter that I visited I found the disease had made serious ravages, and that this was entirely due to the sudden appearance of the climatic conditions fitted for the germination of the spores which existed in the atmosphere, I have no doubt whatever.

152. Then about the disease growing in pits, have you any precautions to recommend for the storage of potatoes in pits?—I have no doubt whatever that the preservation of the potatoes in the air, as has been recommended, on floors separated by a foot or so where by the air is able freely to circulate, is the best method of preserving potatoes from disease, and preventing the development of the disease. I believe, as Mr. Dyer has said, that the heating in the pit is a great means of developing the fungus, and that if you can keep the potatoes free from each other, as has been recommended, that will be the means, as proved, of preventing the development of the fungus.

153. Do you share Mr. Dyer's opinion, that it is possible to produce a potato which is disease-resisting, or more disease-resisting than many of our present varieties?—The result of the experiments to which I have referred was very curious in this respect. I found two potatoes, one early and one late, which, in the different localities, resisted

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resisted disease more than their companions. They were all planted under the same conditions in each locality. Each farmer chose his own method of planting, and used the manure he was using for his own crops. The six varieties had the same treatment in each locality, and it was found that one early variety was less liable to disease than the other, and one late variety than the three others. I think that holds out a hope that a variety may be found which would be less liable to disease; but I doubt very much whether variety will be found which will be absolutely free from disease, because this little fungus lives on the species *Solanum tuberosum*, and in all the varieties we experiment with we are always dealing with the same species, and although we may find plants which may resist the disease more, I doubt whether we shall ever succeed in getting a variety which would be free from disease.

154. You said you set six varieties of potatoes to 20 places in the country?—Yes.

155. I suppose they were planted by the side of the ordinary crops of the farmers?—Yes.

156. On the whole, did they do better than the ordinary crops?—They just suffered as the ordinary crops. I have information which I printed at the time with regard to the varieties that were experimented upon when the tubers were raised, because we examined the individual tubers with the very greatest care to find what proportion of the diseased potatoes there were. The same care was not used with regard to the ordinary crops; but in my visits I was able to detect the disease in the same proportion in the ordinary crops as I found it in the experimental crops.

Mr. *Macartney*.

157. And as early?—Yes.

Chairman.

158. The home of the disease is in South America?—Yes.

159. Do they grow potatoes there in quantities; are they more free from disease, or less free from disease than we are here?—That I cannot answer; I have no data.

Mr. *Macartney*.

160. Do they feed upon the sweet potato, the yam?—That is a totally different plant.

161. I wanted to ask whether the atmospheric influences that you say affect the leaf of the potato when it first appears, are due to the electric state of the atmosphere?—Not at all. I must have made myself misunderstood. They do not affect the leaf.

162. I understood you to say that the disease came through the leaf into the tuber?—I believe that these little seeds which are floating about in the air are resting on the whole of the vegetation of the country; but they will only germinate on the plant to which they belong, and which is their proper host or *nidus*, the potato plant, and they will only germinate there when there is external moisture supplied to them. This external moisture is supplied in our country after the heavy showers we have at the end of July or the beginning of August, which are generally the result of thunderstorms. The presence of electricity or its absence has nothing whatever to do with it; it is the presence of moisture in the air in such a condition that it can be used by the little spore for germination.

Chairman.

163. Have you any remedy to suggest, or any precaution that we should take?—None.

Mr. *Storer*.

164. You think no mode of difference in cultivation, or precaution of that kind, would have any effect?—In these twenty cases, there was scarcely one kind of treatment the same as the other; different lands, different manures, different kinds of treatment, and the only case where the potatoes escaped the disease was in Lincolnshire, where the rainfall was extremely small, and where the particular land upon which it was planted was a very light sand, and there the crops ripened early without any rainfall in the neighbourhood, and they never were subject to the disease.

Mr. *Earp*.

165. Then the spores might have been in the potato plant in that locality, but they never got the necessary moisture to develope them?—To enable them to grow.

166. Apparently, I judge your evidence is in part practical as well as scientific?—To some extent it is.

167. Have you noticed at all the difference which may be experienced between the growth of potatoes under glass produced early, and the experience with regard to potatoes grown out of doors. Did you ever hear of much disease in potatoes grown early and grown under glass?—Yes, I have seen the disease in potatoes under glass in February; I do not believe the appearance of the disease has anything to do with the season of the year, but it has to do with the presence of external moisture. I have seen them in Jersey, where they are grown under glass, and sent very early to our markets, and I found the potatoes largely diseased by the true potato disease in February.

168. The necessary conditions being artificially produced?—Being artificially produced by the amount of moisture under glass.

Mr. *Macdonald*.

169. You said you had no practical suggestion to make, but I rather think you had a practical suggestion, and that was as regards potatoes, for planting at least, being placed in pits. You thought that was highly dangerous, and likely to produce the development of the potato disease. If, therefore, potatoes that were intended for planting were kept as apples are now kept in certain states of America thoroughly dry, what would be the effect, think you, upon the potato in the event of planting and using for seed again; would it be to the advantage of the potato, or would it affect it at all being kept in such a manner?—Inasmuch as we do not know how the disease is carried over, I think in the meantime we ought to use every precaution, and I would strongly recommend that no diseased potato, and no healthy tuber that belonged to a plant, in which any disease had been noticed, either in its foliage, or in other tubers, should ever be used for planting. I should object when the potatoes are gathered, that any tuber from a plant where the disease was known to exist should ever be laid aside for seed. I think that is a great mistake. Probably it is not in this way the disease is carried over, but I think it is extremely probable, but until we do know every precaution should be used to

prevent

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prevent the disease being carried over in that way, I would strongly recommend that no potato should be used for seed which has been connected with a diseased haulm, even although that particular tuber did not show any evidence of disease.

170. Apart from that, do you think that the keeping of the potato dry during the period between the lifting in autumn and the planting again would not be desirable as far as your knowledge goes at the present moment, moisture being the cause?—Yes, I do not believe the disease would develope itself in a tuber which was kept separate from others unless it existed there; it could not get into the tuber while it is being preserved during the winter except by close contact with a diseased tuber, but I think it would be an injurious thing to preserve the tubers to be used as seed, so as to prevent the disease from showing itself to them; I would rather see the disease in the tuber, and so prevent people from planting it; but there is no doubt that for food or for production of starch it would be better to preserve the plants with a free circulation round them, and not put them into pits where the disease from the increased temperature or some other cause would make progress, which it does not when they are preserved on the floor.

171. Have you ever propagated from the green seeds?—I have not myself, but I have experimented with plants that have been so produced, and I do not find they are any more free from disease than those grown from tubers.

172. That is my experience as well. The whole of the seed disappeared on several occasions; that is my experience?—I should say the advantage of using the tuber is that you preserve the peculiarities of the original stock, for the new plants are really multiplications by outtings of one plant, but where you use seed you never can predicate that the product will be the same as the parent.

173. I do not know whether I am in order in following up the question I put to the former witness You have stated that the disease came from South America, which I believe is true; but do you not think it would be highly desirable, and that we really, as far as possible, ought to try to ascertain where it came from, and what its habits are in its home, and also whether we could not by some way or other meet it with experiments made under the care of the Government rather than leave it to the economic laws, as they are called, of the present day?—I do not think the conditions in South America are any more favourable than they are here; and any experiments that could be conducted in America could be conducted quite as well here.

174. You agree with the former witness, that it is really a fungus?—Oh, there is no doubt about that. This is not a scientific theory, but an absolute fact upon which no one who has intelligently investigated the matter can have any doubt whatever. Being one of the judges for a prize offered by the Royal Agricultural Society, for an original essay on the potato disease, I had to read a large number of the essays, and I found that among practical men there widely existed the most absurd views with regard to the disease. I should like especially to impress upon the members of the Committee that this is not a theory, but that it is absolutely true, and has been investigated by scientific men of all countries, and everywhere is acknowledged to be the real cause of the disease; I think it is most important that members should bear that in mind.

175. And you have little or no help as now advised by experiments from the reproduction from existing plants either in seeds, or in sets, or otherwise if the disease is there in the locality?—No.

Mr. *Stewart*.

176. If it is a fungus, could you not destroy that fungus by means of some chemical?—Only by destroying the plant upon which it lives. It is a fungus which lives on a plant, not on inorganic matter, and it only starts into active life when it pushes its roots into the living tissues of the plant, and any action you can take on the fungus would operate on the plant in which it is growing.

177. It is part of the plant?—It is, practically.

178. Is it not your experience that if you plant large potatoes you get in a corresponding degree stronger and healthier plants?—Yes, the first life of the potato plant depends on the amount of starch that is present in the tuber, and when you put a large potato in the ground you put a body with half-a-dozen eyes and a large supply of starch. In the first instance the plant lives upon this starch, and you get everyone of these eyes growing up and producing an independent stem, and so you got a great many independent stems and a very vigorous plant to start with. Then, of course, you have a limited piece of ground to grow your tubers on, and the result is you do not get so large a crop of tubers as if you were cutting your seed tuber into a certain number of portions, and planting them at a certain distance where each plant would have scope to develops its own tubers. In fact, it is the same question as planting wheat by a machine, or scattering it broadcast over the field.

179. Still while you think you get a larger plant by the larger potato, do you think it is for that reason any more free from disease?—Not in the least.

180. Then there is not very much use in picking good seed according to your theory?—Not at all. I found there was no difference whatever when the disease made its appearance. I found no disease at all in the South of England, but in the South of Ireland I found all those specially selected potatoes and the ordinary crops all equally full of disease.

181. Even where the seed had been carefully selected?—The seed sent to the Royal Agricultural Society was carefully and specially selected, for of course it was the very last notion of each competitor to have diseased potatoes in the potatoes which he sent in.

182. I understood you to say, in the beginning of your remarks, that this disease originated, as far as you know, in 1844?—Yes.

183. Was there any disease known before that time?—There were diseases known in the potato, but this disease is produced by a plant which can easily be distinguished from other allied plants, and this particular plant was not known in the Old World before 1844, and it has been known every year since.

184. It is a distinct disease originating in 1844?—Making its first appearance in Europe in 1844.

185. Still

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185. Still it was known in the New World before that?—Yes, I believe it was known in the locality of which the potato is supposed to be a native.

186. We have no idea how it crossed from America?—None whatever. We know it was known in North America, and known in Australia before it was known in Europe.

187. It is the same disease in all parts of the world?—The same disease, produced by the same plant, having the peculiarities of structure by which this plant is easily distinguished.

Mr. *Round*.

188. Do you happen to know whether the East of England is more free from disease than other parts of the United Kingdom?—Yes, much more free. In the report which I prepared, I was able to divide by a line running north and south through Britain, the districts of greatest and least disease, and the whole East of England had much less disease than the West of England, Ireland, and Scotland.

189. Can you give us a practical suggestion for the prevention of the spread of the disease?—My only notion at present is, if it were possible to secure an early cropping potato which would be ripe before the rains at the end of July and the beginning of August. I found a gentleman in Ayrshire, in a district which was singularly susceptible to disease in the autumn, had raised enormous crops of potatoes not one of which was diseased, but then he grew early potatoes, and sent them into the midland counties, where they were sold at a very large price, and he never had a single diseased potato in his own crop. But the potatoes he experimented with he was obliged, of course, to keep on till the autumn till they were ripe, and those potatoes were in every case diseased. His own crop was lifted before the period when the disease makes its appearance.

Mr. *Macdonald*.

190. Did you say Ayrshire?—Yes.

191. Was it that peculiar sandy soil?—No, it had nothing to do with the soil. It was a good loam in which they were growing.

Mr. *Macartney*.

192. Then you recommend the burning of the haulm?—Yes.

193. In all cases?—In all cases where the disease has appeared the haulm ought to be destroyed.

194. And the diseased potatoes?—Certainly. The best method of getting rid of them is to send them to the starch mill, to have the starch still remaining in them extracted, because it has been found that the portions of the diseased potato which are not actually destroyed supply just as good starch as the healthy potatoes.

Mr. *Colman*.

195. Then we may take it as your decided opinion that in parts of the kingdom, where there is the heavier rainfall, there is likely to be more disease?—It depends upon the temperature of the atmosphere as well as the rainfall. You must have a hot atmosphere as well as heavy rainfall. The rainfall in the spring, or early summer, is not injurious like the rainfall in late summer or early autumn.

Mr. *Colman*—continued.

196. I mean rainfall in the autumn. You said just now in the eastern counties there was less disease than in the western counties?—Certainly.

197. Is there any difference in the quality of the potatoes in those two districts, irrespective of the disease; quality, I mean, for culinary purposes?—None at all.

198. You said it originated in Belgium?—It was first noticed in Belgium.

199. Do you know whether it has been much in Belgium of late years?—I fancy it has been much the same in all European countries as here. I have no specific data; I am not aware that there has been less there than with us, but I have no specific information to offer.

200. I had a statement made to me that there had been less in Belgium of late years than here, but that is not within your knowledge?—No.

201. Nor in reference to its state in Germany?—No.

202. As to these experiments at different places, and of different sorts, was that one year, or over several years?—It was contemplated to carry on the experiments for three years; the terms of the prize were that the specimens should be free from disease for three years, but the whole of the varieties were diseased in many places in the course of the first year, and it was thought not necessary to continue the experiment any longer.

203. Do you know that that was a very wet summer?—No.

204. What year was it?—It was 1874; there was scarcely any rain till I got to Ireland, and then some heavy showers began, but it was a dry season up to that time, and the disease appeared with the heavy showers.

205. Is there any record at all as to what manures were tried by the different growers?—Yes, I have a specific statement of all the kinds of manures used in each particular locality.

206. Have you any statement with regard to their using wood ashes?—No, I do not know that that was used for them.

207. And you do not know of that being a preventive against disease?—No, I have heard of charcoal being used as a soil which would grow potatoes, but my experience would lead me to believe that that has no influence on the disease.

208. Have you had experience in burning the stalk; would that leave any ash which could be used for manure?—It would leave very little ash, not enough to be of any practical use.

209. Then if the disease goes from the leaf down to the tuber, could anything be done in cutting off the stalks soon after the disease appeared?—That would save of course the tubers in the stage at which they had arrived, but the destruction of the haulm would prevent the ripening of the tuber. It would prevent any further ripening whatever of the tuber; no further food could be conveyed to the tuber after the haulm was cut off. The question was very properly stated by Mr. Dyer, that it is a question of election for the farmer whether he will take his unripe tubers or run the risk of having ripe tubers with a portion of them destroyed by the disease.

Mr. *Storer*.

210. Have you had any experience with regard to the preservation of the tubers by dusting them very slightly with quicklime so as to destroy the spores?—

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Mr. *Storer*—continued.

spores?—I have not, but I have a friend who has been in the habit of dusting the cut surfaces of his sets with lime, with the view of indurating the surfaces so as to prevent the bleeding of the potato, and also to prevent decay after it is in the ground, but I do not believe that any outward application of that sort would cure the disease.

211. You said something about early sorts?—Yes.

212. Have you ever tried or known persons who have tried or advocated deep planting in November as a specific?—Yes; I think that it is a desirable thing to try anything that will enable the potato to start early into vigorous life in the spring, so that it shall ripen before the autumn rains affect it; but then the potato is extremely liable to frost; and the too early germination of the potato may be detrimental from the injury done to the crop by spring frosts.

213. All early planted potatoes of course are liable to that?—Yes.

214. But would not those probably have greater vitality, so as to force them afterwards into production?—Anything that destroys the growing stem of the potato would be injurious to the crop, but I entirely approve of the suggestion that whatever would enable the potato to start early into life if we can secure it against the spring frosts, would be a good thing.

215. How do you account for the exemption of some particular sorts of potatoes from the disease, when they have been sown in the same districts and under the same conditions when others have had it?—I am not aware of any such case. I have investigated cases which have been brought before me; and the result of the experiments which I took charge of for the Royal Agricultural Society, satisfies me that no potato has yet been discovered that is free from disease.

216. I need hardly ask you whether you do not consider it to be a very dangerous crop to depend upon entirely for support?—Most undoubtedly.

Sir *Edmund Filmer.*

217. There are some varieties more free than others from disease?—Yes; but not exempt.

218. Then do I understand you to say that this disease is spread only by the atmosphere?—Not by the atmosphere, but by spores; that is to say, by the seeds of this plant which are floating in the atmosphere.

Mr. *Barclay.*

219. Do you consider there is any use in taking any precautions to prevent the spreading of the disease, either by means of the tubers or by preventing it in the stems?—Yes; I have said that I think the baulms ought to be destroyed, and that no diseased tubers ought to be planted. I think it would be foolhardy for the husbandman to neglect these almost certain causes of the disease.

220. Do you think that the plant from a sound potato more likely to resist the attacks of the disease than one which had grown from a potato visibly diseased?—In as far as the disease attacks the crops through the leaf, I do not believe that the plant which grows from a diseased potato would be more likely to be attacked than one that grew from a healthy tuber.

221. Do you think the haulm of the diseased potato would have as strong a constitution as the one of a fresh potato?—We have no evidence at all that it depends upon the constitution of the potato. I do not believe the growth of the fungus depends upon the supposed healthy or unhealthy condition of the individual plant.

Mr. *Barclay*—continued.

222. Assuming that the spread of the disease represented a struggle between the vitality of the potato and of the fungus, would there be greater vitality in the baulm of a potato grown from a sound set than the one from a weak one?—I am afraid I cannot assume that. I do not think that would be a legitimate assumption from my knowledge, or from the observations and experiments I have made.

223. Then as far as weak and strong stems are concerned, you do not think it of very much importance whether the stem is grown from a diseased potato or from a healthy one?—No; you understand that if a plant is grown from a diseased potato I should expect that that plant would probably have the disease. I should expect that the disease would appear under any circumstances, apart altogether from the moisture in the atmosphere, because as soon as this fungus gets bold of the potato it does not require any external help for its development, it gets all that it needs in the living tissues and juices of the plant. If you have in the spring a potato plant growing which is infected with the mycelium from the tuber from which it grew, that plant would, as soon as the foliage expanded, exhibit, I should expect, the reproductive branches of the fungus, and inasmuch as this is not known to have taken place, it is proof to me that the disease has not spread from the planting of diseased tubers.

224. Has not the disease made greater progress at one time than another?—I believe that it is entirely due to atmospheric conditions being favourable to its germination.

225. I understood you to say that once fixed upon a plant, the spores would find everything they wanted in the plant, and so one might expect the disease would make uniform progress under all circumstances?—In that particular plant; but the spread of the disease is due to the presence of moisture which enables the spores to germinate.

226. Then you think the disease makes uniform progress in the same plant under all circumstances of climate?—When a plant has been attacked by disease, the disease merely persists until it exhausts the plant, penetrating every portion of the plant, and reaching down to the tubers, and destroying the tubers as well.

227. Are there not some cases where the progress of the disease appears to be arrested in a particular plant, without consuming the whole of the haulm of the potato?—No, I am not aware of any such case.

228. There are different varieties of potatoes affected to different degrees by the disease in the same district?—Yes.

229. But you do not know of any case where the disease has existed in a district where any particular variety has been absolutely safe?—I have found by actual observation that a variety is free from disease in a district where others round it are suffering from it, but I have not found a variety which throughout the three kingdoms has been able to resist the disease in every locality.

230. In

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230. In one particular locality one variety of potato may be quite safe from disease, while other varieties suffer severely?—Certainly.

231. And yet that variety of potato, under different circumstances, and in a different part of the kingdom, is affected with disease in the same way as the other varieties?—That I have found to be the case.

232. Can you offer any suggestion as to the explanation of this?—I believe it may be due to some condition of the skin, the epidermis of the leaf. Some potato leaves have a larger amount of hairiness or roughness of the surface than others; and I thought it was just possible that those plants which had escaped disease, might have such a covering of hairs on the surface of the leaf that the germinating spores had not been able to reach with their roots the leaf itself, and I examined with a microscope the various varieties of the potato with a view of finding out whether there was any epidermal structure which would give an explanation why they were free from disease, but I could not find any such conditions present, and I am quite at a loss to explain it.

233. If there were any difference in the epidermis of any variety, that difference would be likely to be uniform in the same variety under all circumstances in which it might be grown?—Certainly. That difference in the epidermis therefore evidently would not account for one variety being free from disease in one part of the country, and not free from it in another. The remarkable fact was, that there was one variety which was more free from disease in all the localities than others. Although it was not absolutely free from disease, it had less disease and uniformly less than the others.

234. But you could not find any characteristic difference between one variety and another which would account for it?—No, I could not find any which would justify me in founding a theory upon it.

235. What variety was that may I ask?—The "General Grant." Those two potatoes that have been mentioned have come into the market since my work on this subject, and I have not had occasion to experiment upon them.

Mr. *Colman*.

236. Do you know whether that "General Grant" still continues to be free from disease?—It was not free from disease when I made the experiment.

237. Less liable, I mean?—No, my observation of it stopped then.

Chairman.

238. I should like to know; do you think that if there was a very great reduction in the amount of diseased seed sown in a year, say 10 per cent. of the seed as it is sown at present, and that you burnt the whole of the stalks, would you expect a material reduction in the amount of diseased potatoes?—No, I should not. I believe, as I said before, that the presence of the spores in the atmosphere is sufficient to spread the disease over the whole country, and that these spores become active producers of the disease as soon as the atmospheric conditions that I have described secure their germination.

239. In fact if you reduced by nine-tenths the amount of diseased potatoes sown the remaining one-tenth would still be enough to spread the disease?—Yes, that I believe. At the same time I would strongly recommend the destruction of all haulms of diseased potatoes. I think every farmer ought to destroy whatever might be the means of spreading the disease.

240. In a country like Ireland, for example, it would be necessary to make a law, because those small cottier tenants would not destroy it unless you actually inspected their seed. Would it be any use to do that?—No, I do not believe that legislation would be of any value in this matter.

241. Is there any portion in this pamphlet of yours published in 1875, which you think would be of advantage if appended to our evidence?—I do not know. I shall be very happy to place copies of it at the disposal of the Committee.

Mr. *Barclay*.

242. Have you any experience of the best method of storing potatoes?—I have not had much experience, but my conviction is that the best means of storing them for food is to store them openly and separately from each other, as we store apples or any other fruit that we wish to preserve. I think it is not desirable to store them in pits, but to store them in the open air (under protection of course from frost, in some sort of house), and that they would be best stored by being laid free from each other on the surface of a floor or a rack work.

243. Is that for seed or only for food?—Either for food or for seed.

Mr. *Macdonald*.

244. You were asked a question with regard to the cutting of the potato, or the planting it for food. If the disease is present in the tuber, or if it falls, as you have described, on the plant, would it make the slightest difference whether the tuber was full sized, or cut into parts?—Not the slightest.

245. And looking at it economically, dividing it into sets is the proper way of doing it?—I certainly would recommend dividing it into sets. I think it is most important to get one vigorous plant with plenty of room for it to develope its tubers rather than to get ten eyes growing with a sufficient amount of food to enable the ten different stems to grow, but having a small range of earth for the development of the tubers. I believe that a good large tuber divided into four or six portions, and planted in the furrow at proper distances, will produce a larger crop than the same potato planted and springing up with six or eight stems, having a small space for the development of its tubers.

246. So that you do not say that it is a remedy against disease at all, to plant the whole tuber?—Not at all.

Mr. *Eorp*.

247. Have you yourself seen the spores you spoke of on the surface of the leaf of the potato; have you detected them?—I cannot say that I have seen them in the open field.

248. Do you know whether they have been actually detected?—They have been germinated under the microscope, but this was, of course, in the laboratory or study of the observer.

249. Have they been detected on microscopic examination or otherwise previous to their germination?—

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Mr. *Earp*—continued.

mination?—I cannot say that they have been detected in the field.

250. Should you think there is any probable solution of this question, by endeavouring to find anything which will tend to kill the spore when deposited on the leaf previous to the descent of the rain, which might develope it?—No; I think not; I know of nothing.

251. But is that probable?—I do not think it is probable. I do not think we could hope for it.

252. The only remedy that you could recommend would be the endeavour to produce a quality of potato which would resist the disease as it were, which would have natural vigour enough to resist the disease?—My conviction is this, that if it were possible to get a potato which would ripen before the atmospheric conditions for the disease make their appearance that would be the most hopeful way of securing an efficient crop; to get not an early potato alone, but a late potato that would ripen earlier.

253. Do you know anything about the experience of South America on that point. There the climate is, of course, much better than here. Do you find that the development of the disease there arises from the existence of these spores in the same way?—Yes, precisely in the same way.

254. Does the potato mature very much more quickly there than here?—Yes; but it does not grow in the hotter regions of South America. It grows higher up in the mountains, where the air is similar to the potato region of the world. It does not grow on the low plains of tropical regions where the temperature is high, but on the mountain sides, which would correspond somewhat to the temperature of Europe.

Mr. *Barclay*.

255. On both sides of the Andes?—On both sides of the Andes.

Mr. *Macdonald*.

256. Have you turned your attention at all to the dry belts, as they are called, in certain States of America?—No, not at all.

Mr. JAMES CRIGHTON, called in; and Examined.

Mr. *Crighton*.

Mr. *Barclay*.

257. YOU are a retired farmer, near Arbroath, and farm a small farm there?—Yes.

258. You formerly had charge of large farms in Gloucestershire and Hampshire, and farmed there on your own account?—Yes.

259. You first devoted your attention specially to the potato crop in 1845?—I believe it was the year preceding, but I could not be certain as to that.

260. You were in Hampshire at that time?—In Hampshire, on a very fine potato soil, and we had very fine variety of potato. There was disease before 1845, and I think it was the disease before 1845 which induced me to take means to avoid it.

261. You have just heard evidence that the potato disease first appeared in this country in 1844, and you turned your attention to what means might be taken to avoid the disease; what occurred to you to do?—It occurred to me to alter the system altogether, and to take potatoes after lea and plant them in the autumn.

262. You were successful for the two first years by that system?—Very successful; fine crops.

263. What happened in the following year?—The following year they all went after they were in the pit.

264. Being grown in the same way from the lea?—Yes.

265. Did the disease appear in the baulms?—No, not with me.

266. The disease attacked the pits after they were stored?—Yes, in the pits.

267. Was that due to any carelessness in storing them up?—I think not; they were put away in beautiful condition, before anyone else's.

266. Were you fortunate in having mild winters those two years?—Yes, almost always mild winters there.

269. You do not mean to say that potatoes would not be affected by frost if planted in autumn in any winter?—They were not; the spring was the dangerous time if they come early, but they were not with me.

270. On what scale did you plant?—It was only for the use of the Earl of Malmesbury's establishment—three or four acres.

271. The extent was too large for you to take special precautions to protect them from frost?—There did not appear to be any necessity for that.

272. In point of fact, you did not take any precautions to save the crop from frost?—No, I did not; but the frost did not reach them. May I say this, in the following year, when I planted in the autumn again, I dusted them with lime when I planted them in the field, and they were all blighted in the field—a complete failure.

273. So that you do not believe there is any advantage to be derived from planting in the autumn?—I do not.

274. You had afterwards some experience in Gloucestershire in growing potatoes?—I had on a small scale; it is not a potato country.

275. What new system did you adopt there?—The farmer I succeeded told me they were never good to eat, owing to the stiff soil, and I adopted the lazy bed system, planted them on the surface, and threw a little earth out over them. All the time I was there I adopted that system, and they were always of excellent quality. The disease never troubled me there.

276. The result of this new system you think was that the quality of the potato was very much improved?—Very much improved.

277. You returned to Scotland in 1669, and since then have devoted a good deal of attention to the growth of potatoes and strawberries, and other kitchen garden plants?—Yes, I have.

278. When did you begin to raise the potato from seed?—About eight or nine years ago.

279. How do you begin; have you a special method of selecting the "plums," as they are called?—I was

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—I was in the habit of writing rough notes for our local paper, and travelling over the country, and when I saw a fine "plum" I took the liberty of putting it into my pocket. I made a selection from those, and from those plums selected a number again, and that was my first start. They were promiscuous, but generally at that time they were from the Victoria potato.

280. You sowed the seed in April in rows, and covered them with a very small quantity of mould?—Yes, similarly to sowing onions.

281. What sort of plant is it that comes from the seed in the first year; is it rather delicate?—They come up delicate, but they very soon gather strength after cleaning them out. I had a piece of ground prepared, took advantage of a moist day, picked out the best plants, and threw out the weak ones.

282. Then out of the plants which came up, you left single plants at intervals of about a foot or nine inches?—Thereabouts.

283. What size potatoes had you from the seed of the first year?—I had some very handsome ones, and very small ones; not much larger than a pea, the largest being about the size of a hen's egg, and I found those large ones that came to an early maturity were the first to succumb to disease. I was unable to keep them alive for two years.

284. Were they all of one colour and similar form?—Very much so indeed. I had one variety of almond shape very productive, which grew on a very short neat stem, and which I thought would be an excellent garden variety. About the second or third year, they all gave way.

285. The tubers of the largest size the first year from the seed produced tubers which succumbed most quickly to disease?—Yes.

286. After the first year, upon what principle did you select the tubers for replanting purposes?—I chose the handsomest.

287. Did they vary in colour?—There were a good many red ones, and some streaked with red the first time. The red streaks all disappeared, and they became white.

288. After being replanted several times, did the potatoes come to be uniform in colour?—Yes, I have three or four sorts quite uniform, and I think the habit is quite established.

289. Did none of them come all red?—None. At first I had one or two red ones, and some half red, but they disappeared the following year.

290. Did you object to coloured lichen and not plant them?—No, they naturally changed colour; the colour departed from them in the soil.

291. Then the same seed produced potatoes which varied in colour, size, shape, and habit?—Yes.

292. In order to fully develope the potato you selected, you replanted, year after year, the best of the tubers which you had grown from the seed to begin with?—Yes.

293. How many years is it, do you think, before the potato so produced arrives at maturity, or at its best?—I think about the fifth year.

294. And has it by that time maintained fixed and definite characteristics?—I think so.

295. By the fifth year the colour, the shape, and the size, to a certain extent, become determined?—Yes, and the quality.

296. In any cases, did you grow different varieties of potatoes beside each other, with a view of hybridising, and selecting the seed to plant from them?—Yes, at the beginning of the next year I planted them side by side for the purpose of the flowers fertilising each other, and then planted the seed from them.

297. Are you now sowing seed and have been sowing seed of potatoes which have been grown from seed?—I have now some two years old from the first crop, plums produced by potatoes sowed from the seed. I have the produce of them in the garden now.

298. That is, potatoes growing from the "plums" of potatoes which were raised from "plums" four years ago?—Yes.

299. What do you hope to get from doing so?—At present there are eight or ten distinct strong robust stems formed, which, in my experience, will turn out, I think, to be a very strong variety of potato.

300. What are the favourite varieties in Forfarshire at present?—The favourite is the Champion, by far.

301. And the next?—Something in the shape of a Regent. The Victoria is nearly gone out.

302. How do you describe the appearance of the Champion potato?—It has a much more robust habit of growth than any other. The tuber is a white round tuber, generally pretty good sized; very few small ones. They are a little deep in the eye, but there is very little waste.

303. What do you say as to the quality?—They are the very best that I know at the present time, and I am in the habit of testing all sorts that I can come at, and comparing them.

304. Are there two kinds of Champions in Forfarshire?—I think there are; they have diverged, probably, from one parent. One is not quite so good in the colour as the other, and rather coarser.

305. Now, as to the habit of the plant?—The habit is very robust and strong. I think a great deal of its power of resisting diseases is owing to that. When you take hold of the stem as it is growing, you find it firm in the hand.

308 Is it slow to begin to form its tubers?—Rather slow.

307. But, having begun, they grow rapidly?—Very rapidly.

308. Is there any difference in the appearance between the two varieties of the Champions to which you have referred?—Not a bit. If anything, the other is a little bit more coarse in the stem as well as in the tuber. I have thinned out all the coarser varieties from what I have planted myself, and only use the finer varieties.

309. How do you recognise the coarser variety?—You can tell them by the eye; they are a little yellower in the flesh if you cut them.

310. What do you say are the qualifications of the Champion potatoes?—They resist the disease far more than any other. One year I noted particularly. I am in the habit of walking over, perhaps, a thousand acres of potatoes in the season, when the potatoes are growing, and when they are being taken up, and in every way, and about two or three years ago, when there was barely 5 per cent. of rejections in the Champions, I found there was 20 to 30 per cent. in the other varieties in Forfarshire, rejections on account of the disease.

311. Then the Champion is not proof against disease, but only less subject to disease than other varieties?—

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varieties?—There was less than five per cent. diseased in the pits, when they were being sold out.

312. And how much disease would there be in the other varieties?—Twenty to thirty per cent., at the least.

313. As to the size of the crop produced by Champions?—In what I have tested myself, on a small scale, the Champion exceeds them by at least two tons an acre, one year with another.

314. What proportion is that?—Nearly a fourth.

315. Have you any idea as to what we may call the life of a given variety of potatoes?—The idea that I form is this, that you cannot depend on the life of any variety beyond 20 years. It draws near the end of its tether, as we say, then.

316. That is to say, a variety appears, and has considerable attractions about it, is generally adopted, and after about 20 years it begins to show signs of weakness in certain directions, and at last its cultivation is entirely neglected?—Yes, I may say at the same time on that point, that I believe by judicious management the life may be prolonged a few years more.

317. Then what steps do you think should be adopted for the discovery of these new varieties of potatoes, or for encouraging their production, or for preventing the disease?—I think that new varieties might be encouraged by local agricultural societies giving prizes for one or two perches of new varieties annually; and I would have those plots examined by the judges in the different stages of their growth, and see them taken up and test them. That would be an encouragement to the propagation, because it does not pay anybody; there is nothing made out of it. I think that would be more judicious than to attempt the thing by Government taking it up.

318. Returning to the Champion potato, do you think it is better adapted for wet soil and moist climates than the other varieties?—It is better than any other that I know. I have planted them in the very wettest land I have, and I tried them there.

Chairman.

319. There were a good many Champions sent to Ireland this year?—A great many.

320. But do you think that half the potatoes that went to Ireland are real Champions?—All that were shipped from the port where I live were genuine Champions.

Sir *Harvey Bruce.*

321. When you were in Hampshire, did you use the same kind of seed all the years, as in the two years that were successful?—The same seed.

322. What was it?—It was a sort of Regent, a very fine potato indeed, and after that, when I lost that variety in 1845 and 1846, the Jersey Blues, I think, came into fashion, and they stood the test all the time.

323. You said that you used lime the last year, and that the potatoes went sooner after the use of the lime?—They did.

324. And did you use the same manure each year?—The same farmyard manure?

325. No, artificial?—No artificial manure whatever.

Mr. *Macdonald.*

326. You say the Champion is freer from disease than other sorts; did you sow Champions in a place surrounded by timber or anything of that kind?—My little plot is surrounded by timber; I have tried them in every corner of it; in the wettest and in the driest and in the shadiest part; in every possible way, with cut seeds, whole seeds, large tubers, and small tubers, and I have found it in every way stand the best.

327. I am afraid my experience is not yours, as far as the Champion potato is concerned; however, what kind of soil had you?—Mine is a very bad soil naturally; it is taken off the moor; a very close panny subsoil.

328. In growing your seeds did the disease attack your plants at all?—It did.

329. In the first year?—In the first year; I have seen them no larger than a pea, with the disease fully developed; I have seen the disease take them and entirely destroy the plant.

330. In the first year did it attack them wholly, or only in part?—Only partially, here and there a plant.

331. In the second year did the disease increase in the plants you so tested; you said you selected the handsomest tubers; by that I understood you mean the tubers that you thought were most in conformity with the Champion potato?—Not exactly for that, without reference to any other sort; if it was a very nice handsome looking potato I selected it for seed, and any unshapely ones I flung aside.

332. There was a certain attack in the first year; did the attack increase in the second year?—Year by year; some of them succumbed, and a few stood out to the present time, and they have withstood the disease to the present time; I have three or four varieties that appear to be disease-proof, but all the rest, forty or fifty varieties, or more than that, have quite succumbed.

333. That is exactly my experience; of those that you have now and are retaining, a certain number have died from disease, in passing from year to year?—In passing from year to year; but I have some now which appear to be disease-proof; this season will prove whether they are or not.

334. Have you never had disease in that plant at all?—No.

335. How many years have you had that plant now; what is the age of it?—About five years old.

336. During the whole of those five years you have had no death?—No disease in those.

337. You were asked the question if your potatoes exhibited a variety of colour; that is, those that you propagated; have you not found that there was a tendency to a variety of colour, even in those coming from a single potato?—Except the first season, I have not had them coming of different colours; the reason of that is I have not planted potatoes of different colours in juxta-position.

338. You are of opinion that by careful attention to the propagation of the potato, you could get tubers without disease?—I believe that by following that system out carefully that in time I shall arrive at the solution of the question; I shall get one almost disease-proof.

339. Then have you made your selection for propagation from other plants than that of the Champion?—Oh, yes; I have had a good many from the Victoria, and my hopes are fixed now on the

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Mr. *Macdonald*—continued.

the second race; that is a plum from a plum; that is the second descent. They look stronger than any that I have.

340. And was that from the Victoria?—That was from the Victoria "plum," growing alongside and mixed with Champions.

Mr. *Stewart*.

341. Is it your experience that planting in sets is more efficacious; that is to say, by cutting one potato into three or four sets, or do you think the planting the whole potato, giving it rather more room, is better?—I prefer a medium-sized potato; perhaps about eight to the pound; I think that is the most profitable plant to set.

342. But that potato is cut up?—No, I do not cut the two-ounce ones, but if they were larger I should cut them, but I prefer going over them and picking out all the handsome potatoes of that size for seed.

343. And planting them whole?—Planting them whole.

344. And using no other manure than farm-yard manure?—If the land is in fair condition and the farm-yard manure is made under cover with a little cake in it, they require nothing else, but if the land is poor and the farm-yard manure is poor, I should add some kainet and dissolved bones.

345. How many carts of manure would you put to the imperial acre?—When the land is so poor as to require a big dressing, I put 12 loads to begin with and 12 afterwards.

346. That would be 24 loads to the acre?—Yes.

347. Then you have had no experience in the employment of any sort of top dressing or chemical dressing, with a view of increasing the health of the plant?—No; with the exception of soot and kainet.

Mr. *Round*.

348. Have you much experience of the Magnum Bonum?—Not much. I have planted some this year beside the Champions. I have sowed seeds of equal size under the same conditions.

349. You have not had much experience of it?—No. There are not many in our neighbourhood, and what there are the quality is complained of.

Mr. *Colman*.

350. What is the quality of the Champion, as a potato?—Very fine quality of potato indeed.

351. In wet and dry seasons?—Yes.

352. Have you had any experience in using wood ashes as a manure?—I spent five winters in Upper Canada, and it was used there on new ground for potatoes The ashes were spread over the ground and the potato was planted on the surface, and the ashes swept over it.

353. Do you know whether that had any effect on the disease?—I never knew any instance of disease while I was there.

354. Either when manured with wood ashes or otherwise?—I never grew any in any other way. I went back into the Bush and that is how I grew them. I never saw a diseased potato to my knowledge.

Mr. *Barclay*.

355. But when was that?—From 1832 to 1837. The potatoes throve uncommonly well.

Mr. *Colman*.

356. You have not tried your autumnal experiments since?—No. I was very proud of my success at first, but afterwards I was so disgusted that I never tried it again.

357. You say you have never applied soot to the roots of the potatoes, but only as a top dressing?—Only as a top dressing.

358. With regard to deep planting in Hampshire; you planted them in the winter for two years successfully, the winter being mild probably, and the third year they failed?—They failed.

359. What depth did you plant them?—They were planted at the bottom of every third furrow.

360. But how deep?—There would be about seven inches of soil on the top of them.

361. So that in a very severe winter they might be affected by the frost?—They would be in Scotland, but not in Hampshire.

362. Then do you approve of the system of planting in autumn in preference to spring?—I do not. I find that if I want an early potato, the best way is to take the seed into a warm place a little bit before planting, and not to plant early, but to sprout them, and they come early very much more easily than those that have been in the ground all the winter.

Mr. JOHN NICHOL, called in; and Examined.

Mr. Nichol.

Mr. *Barclay*.

363. AT present you are residing at Arbroath?—Yes.

364. It was you who produced the Champion potato of which we have heard so much now-a-days?—Yes.

365. It was in 1862 that you first sowed the seed that ultimately produced the Champion potato?—Rather in 1862 I planted potatoes with a view of obtaining seed which I sowed afterwards.

366. Where was that?—At Ochterloney.

367. What potatoes did you plant?—I really do not remember the names of the potatoes. They were new sorts at that time. I had been greatly interested in the experiments that Mr. Patterson had been carrying on for a number of years in introducing new potatoes, and I rather think that one, at least, of the kinds I used was from his new sorts. There were two white potatoes and one red one.

368. You selected the best plums from those potatoes and preserved the seed, which you sowed the following year?—I did.

369. Then what was produced the first year from the seed?—I had a large number of plants, the best of which I selected and planted, and from the product of these I selected the best, setting aside a great number of sorts that appeared at that time worthless, and keeping the best and most promising as to appearances; not altogether the prettiest of the lot, for I rather think that some of the most beautiful potatoes at

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Mr. *Barclay*—continued.

first sight do not always turn out the most profitable afterwards. I think a rough looking potato at first sight is more likely to produce a plant with a strong constitution rather than a smooth one.

370. You selected, to replant, those tubers which according to your ideas seemed to have the strongest constitution?—Yes.

371. Did the seed produce varieties of colour and size and form?—Yes, varieties of colour, size, and shape.

372. Did you find that, in selecting the tubers to be planted, those tubers maintained uniformity of colour and form from the beginning, or did those vary from year to year?—They maintained uniformity; that is the produce of one seed, the tubers of which I preserved, maintained their uniformity in a general way. In the course of succeeding years continuing the experiments, there were slight variations as to colour, form, and strength, and growth in the haulm, and otherwise, but in the main it was uniform. The different tubers had a uniformity.

373. They maintained their individual characteristics in succeeding generations?—Yes, with slight variations, which came on gradually.

374. Did the potatoes continue to develope from year to year, as you selected them?—Yes, they developed; those that were very rough at first lost considerably their roughness and got more shapely in their form. The white ones, that perhaps had red eyes, lost in the course of time the redness of the eyes, and became almost pure white.

375. You pursued a system of what may be called artificial selection, according to your ideas, of what constituted the best varieties of potato?—Yes. I started with a large number, and in a few years reduced them to a comparatively small number of what appeared to be good varieties.

376. How many years do you think pass before a potato has acquired fixed characteristics, or arrived at its highest form of development?—I should say that a seedling potato treated as I have described it, may be depended upon in a general way for having attained its characteristics in five or six years (that is grown from the plum); I should say from that time it may be depended upon for growing in general cultivation, and after it is once in general cultivation I should expect with good treatment, and being shifted into various soils and situations, better perhaps than that in which it has been grown, there might be a further development in the quality of the potato.

377. Has the Champion potato improved since it passed from your care into general cultivation?—Yes, as to quality; it is not nearly so strong in the haulm. The haulm at first was excessively strong, and the consequence was that farmers at first planted them a great distance apart. They however found that that was not profitable, as it led to very large coarse tubers, but not so good in quality, and for a number of years past they have been planting them much closer. The consequence has been that the haulm is not so strong, but they produce tubers better in quality.

378. What do you say is the characteristic of the Champion potato, as distinguished from other varieties?—The whole habit of the plant is much more robust than any other variety that is grown in our district; it seems more able to resist fluctuations in climate and soil than any other varieties. The appearance of the tuber itself is not very prepossessing; rather rough; a flattish round potato with rather deep eyes, which some people consider prejudicial to its use, but the quality is very good. There was for a number of years at first, an inclination to a yellowness in the flesh; this has mostly passed away in places where it has been well cultivated, and the flesh is now comparatively white.

379. Do you think they produce a larger crop than any other variety?—Well, of course I have not much experience of growing them myself, but I have been in the habit of getting communications from various quarters in England, Ireland, and even the Continent from parties who grow them, testifying to the very large increase of production, and the immunity from disease.

380. Then it not only grows a larger crop than almost any other variety, but also it is not so liable to disease as any variety that is known in Forfarshire at the present time?—Yes, I think there is no question about that.

381. You have adopted another system of hybridising by grafting two potatoes of different varieties upon each other?—Yes, I have tried that system, and I have been successful in obtaining different varieties.

382. But I understand the experiments are not sufficiently advanced to allow you to form very certain conclusions?—Well, the conclusion is quite certain as to the possibility of producing a different sort; I cannot say with certainty of producing a sort superior to those which I have grafted from; it requires some time to prove that.

383. But that is one system of hybridising the potato?—Or rather changing the variety; it can hardly be called hybridising.

384. Do you concur with Mr. Crighton in thinking that the life of a variety of potatoes is about 20 years?—Yes; I have paid very great attention to that, and looking over the history of the potatoes in our neighbourhood, I find that those which exist now, and which are beginning to show signs of decay, came into general cultivation about 20 years ago. I remember the Victoria coming into general use, and I find in our district now the Victoria is considered a very uncertain potato from which to expect a crop, and the Regents too are not anything like what they were some years ago, and I think it is about the same number of years since they came into general cultivation in our district.

Chairman.

385. You have received a great number of communications to say there has been great immunity from disease from different quarters?—I have.

386. Could you say more particularly from what parts of the country; could you go a little more into detail about that?—Some communications I have had personally from individuals, and some by letter. For instance, I was called upon this spring by a gentleman from the South of Ireland; I do not really recollect his name; a large importer of potatoes, and also a large grower of potatoes, and he said to me that he had grown the Champion in the neighbourhood of Dublin to a large extent, and that compared with other varieties in Ireland, it was an immense way ahead

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Chairman—continued.

ahead of them, and that the Champions grown in Ireland were of better quality and sold better in the market than those imported from Scotland. He said he could get 20 *s.* to 30 *s.* a ton more for Irish-grown potatoes than for Scotch; I understood that to be for use and not for seed. Then I have had communications from a gentleman in the neighbourhood of London here, a Mr. May. There was a letter of his appeared in the "North British Agriculturist" about four or five weeks ago, stating his experience of the Champion, which he plants exclusively to the extent of 100 or 150 acres, and his results he speaks of as being 10 to 11 tons of marketable potatoes, besides two tons of smaller potatoes useful for other purposes.

387. Has the Champion any peculiarity about the manure that should be used with it?—No; I do not think there is. The Champion, the same as all other potatoes, I think, would be damaged by exceedingly strong manures: manures that would make it grow to a very great size, but I am not aware that there is any peculiarity with regard to manures.

388. About what time in the year do they put Champions in in Scotland?—They are a comparatively late potato; they are fit for use nearly as soon as the Regent.

389. About what day of the month should you say?—Well, I should say that would be about the end of August.

390. You have said that the life of a variety of the potato was about 20 years?—Yes.

391. When would you say that the life of the Champion had commenced; you began your experiments in 1862?—I should say a year or two from this time; speaking of the Victoria and Regent, when they came into general cultivation, such as we find the Champion now come to in the Eastern part of Scotland, I should say the Regent and the Victoria had been in cultivation for a considerable number of years before that on a small scale, and speaking of the Champion in the same way, I should say it would be, perhaps, a year or two old at this time.

392. Then its 20 years would date from about 1878, or some year like that?—I sowed the seed first in 1863, but in speaking about the life of a potato as a cultivated plant in general use, I said that about 20 years seems to be about the limit that it would remain in profitable cultivation ordinarily in the field.

393. When would you say the 20 years commenced for the Champion potato?—Well, a year or two.

Mr. *Stewart.*

394. Have you anything to suggest to the Committee with regard to the reference before us as to diminishing the frequency of the disease to the extent of the failure of the potato crop?—Well, with existing varieties, I think the utmost that can be done in the way of protection is such as has been adverted to by some of the previous witnesses, but my main hope is from new varieties that may be disease-proof. There have been two mentioned here, the Magnum Bonum and the Champion, and from those and four similar varieties I expect we may get others that go still further in the way of being disease-proofs. Reference has been made already by Mr. Crighton to the getting of seeds by selecting good plums just as he found them promiscuously in the field. I would not depend too much upon that. I would select the plums from particular sorts, and, although I do not do it in the case of Champions, I would hybridise them artificially to make sure that I had the exact varieties that I wished to raise. You cannot be sure, in the case of taking a plum from a plot of potatoes, what is the source from whence the pollen comes which produces the variety. I remember on one occasion getting from a friend some seed plums, and I had the expectation that, as his sorts were really good, I should get a fine selection of seedlings. The result was absolutely worthless. There seemed to have been too many sorts together; at least, that was my idea.

Mr. Stewart—continued.

395. Then the great object in growing from plums is not to perpetuate the variety from which you take the plums, but rather to experiment so as to produce further varities?—Quite so, something better; or to produce some result that you have in view which is not in the old one.

396. Have you ever tried the experiment of mixing the pollen of two potatoes with hardy constitutions so as to produce something equally hardy?—Yes, I would take the pollen from one variety and put it on the other plant.

397. Have you done that?—Yes.

398. With good success?—Oh, yes; I have young plants of potatoes looking remarkably well, and showing definite appearances, even in the leaf, of the source from which they came.

399. And that would be the most effectual way of diminishing disease and giving the public a hardy potato?—Yes; that has been my experience for a considerable time, and I have been very much confirmed in that from what I heard the scientific gentlemen say here to-day.

400. An honourable Member asked you about Champions; it may be called a late potato, may it not?—Yes.

401. What is the best early potato, in your opinion, that is grown?—In field cultivation, do you mean?

402. Yes?—In our district there is not much done in the way of very early cultivation. We are not situated very well as to climate for the growth of those, and in gardens there is such a variety used that I could not very well make a selection. I have myself grown some of Breezes' varieties. They do very well in the garden, but they seem not of such a constitution as would at all suit for the field.

403. Can you make any suggestion to the Committee as to what you would manure these potatoes with, whether farm-yard or chemical, or a mixture of the two?—Well, I have had a little experience in my own way, and as far as I have seen I would be inclined to prefer farm-yard manure well rotted.

404. With nothing to force them at first?—Well, if the soil is poor, a little artificial manure may be good as a stimulant.

405. Have you had any experience of winter planting?—No, I cannot say I have. I do not think that winter planting in our district at all would do, and, besides, I do not think that winter planting in the main would be a very good thing. I have an idea that the soil would not be in that free and porous condition, after lying all the winter exposed to the weather, that would be favourable to the growth of a large crop of potatoes.

406. And if you had any early spring frosts it would be most destructive?—Quite so. In our district

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district we have the potatoes sometimes destroyed by frosts in June.

407. You have never attempted any plan of washing the haulms to try and get rid of the fungus?—No, I have not.

Mr. *Colman.*

408. In giving the life of the potato as 20 years, I presume you mean that at the end of the 20 years it not only deteriorates in quality, but becomes more liable to disease?—Yes. I would not be so positive of that. I am not so sure about its increasing the liability to disease. I have before my memory an instance of the Victoria potato when it newly came out, in about 1864. I planted a small quantity of them then, and they grew remarkably well and there was an exceedingly heavy crop, both as to roots and plums; in fact the plums lying in the drills at the side seemed almost as large as the roots, but every root became thoroughly diseased; there was scarcely a sound tuber in it. My impression is that some varieties of potatoes are essentially liable to disease, and I do not think the Victoria, although it seems to a great extent worn out now, is more liable to disease than it was in its youth.

Mr. *Macartney.*

409. You were saying that in your opinion the life of a particular kind of potato is 20 years; the beneficial life?—Yes.

410. Speaking of the Regent, do you mean the York Regent or the Edinburgh Regent?—I rather think it will be the Edinburgh Regent that will be in use about us.

411. The York Regent was an English potato, and the Edinburgh Regent was produced in Scotland from the York Regent?—In our district we simply call them Regents.

412. The Regent was a Yorkshire potato, and it was in very large use in London at one time. Then its place was taken by the Edinburgh Regent, which was an off-shoot of the York Regent produced by Mr. Pattison, was it not?—I am not aware.

413. I want to know whether the Regent is still in cultivation in Scotland beneficially?—I can scarcely say beneficially.

414. Is it not sent to London in large quantities now?—Not from our district.

415. The Edinburgh potato used to be the great potato in London?——

Mr. *Stewart.*] I can answer that it is sent.

Mr. *Macartney.*

416. You know nothing about the Delmahoy?—No.

417. Or the Kemp?—I do not think that was a potato in cultivation in the north-eastern district of Scotland.

418. You have no practical knowledge as far as regards the growing of the early species of potatoes, I think you have said?—As a gardener I have had some experience in growing early potatoes.

419. Have you found the early potatoes more subject to disease than the late potatoes?—I cannot say that I have, but the early potatoes are grown and stored mostly before the time that the disease generally makes its appearance. The disease in the eastern part of Scotland generally

Mr. *Macartney*—continued.

makes its appearance later in the season than the early sorts are grown.

420. Did you ever try a potato called the Ash Leaf Kidney?—Yes.

421. Did you find that particularly subject to disease?—No, I cannot say that I have.

422. And another called the Fluke?—Yes, I have had the Fluke; that is not strictly speaking an early potato.

423. Of the shape of the kidney potato?—Yes. It has been grown pretty largely in our district for export to London and the southern markets, but for a few years past it has been going out of cultivation; that and the Victoria seem to be somewhat similar.

424. Did you ever try an Irish potato called the "Skerry Blue"?—No, but I have heard of it from some correspondents in Ireland as being a very good potato.

425. As being sound and not subject to disease?—There was no special information as to disease, but it was spoken of as being a very good cropper of good quality in certain districts.

426. Have you ever tried experiments in arresting disease in potatoes?—No, I cannot say that I have tried any experiments. My experiments are mostly very elementary; they are but small in extent, and I do not devote so much attention to that as to the getting of new varities.

427. I mean this; at one time farmers, when the appearance showed itself in the tops, tried the cutting of the tops off, thinking that it proceeded from the leaf to the tubers, thereby, as they thought, saving the tubers when they were full grown?—Yes, I have tried that. It is a considerable time ago, but as far as my memory serves me it was only partially successful. It did not altogether prevent the disease; but then the disease might have, before that, descended to the tubers. I could not make sure of that.

428. I mean on the first appearance at a late period of the season. You heard the evidence given by a witness here to-day, that in his opinion the fungus was there, and that it was developed by the first moist weather or rains in the autumn?—Yes.

429. What I wanted to know was, whether at that period when you might expect the disease was beginning to show itself, you have ever made the experiment of cutting off the tops?—Yes, but anything I have done in that way was on so small a scale that I could not depend upon it being worth much. My experience of the appearance of the disease agrees in the main with what Mr. Carruthers said in his evidence.

430. In keeping potatoes do you put them into a pit?—Yes, if there is a large quantity, but I consider, unless very carefully done, the potatoes put into a pit are liable to have the disease developed.

431. Then how do you store your potatoes?—Suppose a garden is concerned, I would store them for seed in a house in such a way that there would be no moisture about them for heat to act upon them to develope the fungus.

432. And would you ventilate the place?—Yes, as far as possible, without allowing the frost to act upon them.

433. Would you admit light?—Not much light; light would not hurt them, as far as the seed is concerned.

434. But it would make them rapidly advance?—It would green them and make them unfit for

Mr. *Nichol.*

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Mr. *Macartney*—continued.

for food, but the greening does not destroy them for seed.

Mr. *Barclay*.

435. Speaking of the life of a variety of potatoes, the meaning is, that the variety remains popular for about 20 years?—Yes.

436. It gets into public favour by certain qualifications which it possesses; then after those qualifications get lost, either as to quality, size, crop, or disease, it falls out of popular favour again, and that period during which it lasts in popular favour you consider the life of the potato?—Yes.

437. And that period is about 20 years?—Yes.

438. And you reckon that the Champion potato became popular about three years ago?—Yes, in our district.

439. You found a very marked distinction in your district between the per-centage of the Champion potatoes that were diseased and the old varities?—Yes; most parties speaking of the disease in the Champions, speak of it as traces simply.

440. Have you any suggestions beyond selecting good sorts, to offer?—That is with the existing sorts?

441. With either the existing sorts or new sorts that may be developed, or in respect to legislation that might be devised to meet any case?—I should say that the most that can be done by a farmer is the selection of the most likely tubers, the freest disease possible; and I also think it is a great advantage that the seed should be changed from one locality to another. I think there has been too little attention paid to that. It is my belief that potatoes grow better when they are changed from one quality of soil to another, and perhaps from one climate to another. There is a great difference between the inland parts and the coast line. Then with regard to the cutting of the seed, it is important to pay attention to that. I can remember when it was a common thing for farmers to cut great quantities of their seed at one time, and lay it up in large heaps, and the seed would get into a sort of fermented state there. Then they were taken out, possibly upon a dry day, and thrown carelessly into the drills. The seed so treated I do not think was fitted to produce a strong healthy plant. Then as to the manures, I think the avoidance of very stimulating manures, or manures such as would cause a rank growth in the haulm of the potato, should be avoided. It is my impression that manures used by farmers in the neighbourhood of towns, when put on to a large extent produce strong growth, and a large crop at the earlier part of the year, but also make the plants very liable to disease.

Mr. *Macartney*.

442. Have you ever tried a potato called the "Flounder"?—I have not tried it myself, but I have heard it spoken of very favourably.

Friday, 18*th June* 1880.

MEMBERS PRESENT:

Mr. Barclay. Sir Hervey Bruce. Mr. Colman. Mr. Creyke. Mr. Earp. Sir Edmund Filmer.	Mr. Macartney. Mr. Macdonald. Major Nolan. Mr. Round. Mr. Stewart.

MAJOR NOLAN, IN THE CHAIR.

Mr. THOMAS M. NICOLL, called in; and Examined.

Mr. *T. M. Nicoll.*

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Mr. *Barclay.*

443. YOU are a farmer at Littleton, in Forfarshire?—Yes.

444. You have a farm of about 300 acres?—Yes; about 300 acres.

445. You were last year President of the Scottish Chamber of Agriculture?—Yes.

446. About how many acres of potatoes do you grow annually?—From 20 to 30 acres.

447. Have you also inquired and made yourself acquainted with what is the general practice of growing potatoes in Forfarshire by those who are considered the most successful producers of potatoes?—I am acquainted with the general practice.

448. What is the general quality and description of the soil you farm?—Light friable soil, with a gravelly subsoil.

449. All drained, or dry naturally?—Naturally dry.

450. Do you think there is much hope of success in growing potatoes on a wet soil?—No.

451. What is the rotation in which you farm?—The rotation is what we term an eight rotation. After three years grass we have oats, potatoes, wheat, turnips, barley, and then seeded.

452. Then the potatoes are not grown twice in the same land for many years?—Within eight years.

453. That is three years grass, two years green crops, and three years grain?—Yes.

454. In what part of the rotation have you hitherto grown the potatoes?—After oats.

455. The oats come after, what?—After lea; grass.

456. Are potatoes in some cases grown immediately after the lea?—Yes.

457. Have you adopted that recently yourself?—I have.

458. Now in preparing the land, how do you set about it; when do you begin to plough?—We plough early in autumn; the furrows are exposed to the winter frost, and if the land is thoroughly clean, I simply harrow it down and drill it up for potatoes in the spring. If there is any wildness, then of course it has to be grubbed up in spring, in addition to the harrowing.

Mr. *Barclay*—continued.

459. What is the size of the drills?—Twenty-nine to 30 inches.

460. What distance apart do you put the sets?—About a foot.

481. With regard to manures, how do you manure the potatoes?—With farm-yard manure in the drills.

462. What quantity?—Twelve to 14 tons an acre.

463. Any extraneous manures?—Yes; partly potash, and partly super-phosphate.

464. The extraneous manures are either phosphatic or potash?—Both combined.

465. About what quantity do you apply?—About 3 cwt. of potash, muriate or sulphate of potash, and 3 cwt. of super-phosphate.

466. The manures are applied in open drills, and then covered in?—Yes; then covered in at the time of planting.

467. How do you proceed with the potatoes next; harrow down the drills?—In the course of a few days we harrow down the drills, and then loosen the soil by grubbing and harrowing between the drills; we then hoe the potatoes once or twice if necessary, and when they are well grown, we put the earth to them and allow them to stand and ripen.

468. After the haulms are well grown the potatoes are furrowed up by a plough?—Furrowed up by a double plough.

469. That finishes the work upon them till the time to dig them up?—Yes, to raise them.

470. Is that pretty much the uniform practice in Forfarshire?—Yes. With regard to the rotation, I might say, if the land is a little stronger, of course one year's pasture may be dispensed with. In light friable soil three years' pasture is the practice.

471. What do you reckon to be the total cost of producing an acre of potatoes, including rent, labour, seed, manure, and so forth, and including delivery at the nearest station, within a few miles distance?—Well, that depends on so many factors, the rent and the amount of manure applied.

472. We

Mr. *T. M. Nicoll.*

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Mr. *Barclay*—continued.

472. We do not want a close calculation, but simply about what it usually costs you to produce an acre of potatoes, including the charges to which I have referred?—£.15 or 16*l*.

473. You speak always of an imperial acre?—Certainly.

474. What average crop about do you expect from the land?—I consider six tons a good crop.

475. What is the largest crop that you have had according to your idea?—Probably a ton more.

476. As much as seven tons per acre, and I suppose sometimes as low as five?—Yes.

477. According to those figures a ton of potatoes delivered at the railway station would cost you somewhere from 50*s*. to 55*s*.?—Fifty shillings per ton I consider is the cost of potatoes to grow them on the method adopted by me.

478. Do you cut the tubers for seed, or do you prefer to plant whole potatoes?—Partly both ways. I dress them through a 1⅝ inch riddle, and what goes through the 1⅝ inch riddle and remains above a 1½ inch riddle, I plant whole; if I do not dress them with a 1⅝ inch riddle, then I cut those larger ones.

479. Those that are larger than will pass through a 1⅝ inch riddle, you cut up?—I cut up.

480. Have you any decided preference for the one description of sets over the other?—All things being equal, I prefer the whole sets, but I have not noticed much difference.

481. What kind of potatoes do you plant?—Champions and Regents, and occasionally some Victorias.

482. Are Champions and Regents the predominating varieties grown in Forfarshire?—Yes.

483. What do you say is the character of the Champion potato?—It is a late hardy variety, which seems to thrive well in cold, wet, sunless seasons, and is almost disease resisting; and also it has very little refuse.

484. By refuse, you mean small potatoes?—Yes, useless potatoes, except for feeding purposes. I have known 70 tons of Champions to be delivered, with a refuse of only 30 cwt.

485. As to the quality of the potato itself; what is your impression?—I do not think it is so good as Regents in ordinary seasons.

486. The eating quality you mean, I presume?—Yes.

487. Is it your experience that you get, in a wet and rather cold season, a larger crop of Champions, and less disease amongst them, than any other variety with which you are acquainted?—Yes.

488. Do you think this variety of potato is more suitable for a rather wet climate, and rather cold wet soil, than any other variety?—I believe, if I farmed in the west of Scotland or Ireland, I should plant Champions almost exclusively, with a few Regents for early use.

489. What is your idea with respect to the Champions in a rather dry warm season?—I do not think they would be so satisfactory then. You have a better return from Regents in a season ordinarily favourable to potato culture.

490. You think, in a rather favourable season, you would have a larger crop and better quality, and quite as free from disease, if you were to raise Regents?—We should have a more valuable crop, I think.

Mr. *Barclay*—continued.

491. According to your experience hitherto, have you had much disease amongst the Champions?—Not much.

492. A very much smaller proportion of disease amongst them than amongst the other varieties you have raised?—Yes.

493. What is the variety of the potato that has been longest in use in Forfarshire?—Regents: that is at present grown.

494. Do you think there is any difference in the character of the Regents since you first began to raise them?—I do not think so.

495. You do not think that, taking everything into account, the Regent potato is more subject to disease than it was 15 or 20 years ago?—I do not think so.

496. Or that it grows any poorer a crop than it did then?—No.

497. You think, I suppose, on the whole, that potato growing is rather a hazardous crop?—The returns from potatoes are extremely fluctuating.

498. And the risks very considerable in growing?—And the risks very considerable in growing.

499. While a very considerable amount of capital is necessary to raise a paying crop?—They are not a crop which I should like to grow to depend on them for paying my rent, far less existing upon them.

500. When do you begin to plant the potatoes?—At the beginning of March.

501. That is about as early as you can venture to do so, on account of the late spring frosts?—They are seldom planted out earlier than that.

502. Would you plant them earlier if it were not on account of the frosts?—I have planted earlier. I have planted in the middle of February; but the ordinary time is from the beginning of March to the middle of May.

503. Do you think it is disadvantageous to plant as early as the middle of February?—No, I cannot say so.

504. You put the potatoes in as soon as you are able to do so from the state of the weather?—Yes.

505. What time are they usually ripe with you?—In October.

Chairman.

508. You say you plant Champions, Regents, and Victorias; used you to plant any other kind formerly?—Yes; Rocks, of a light coarse variety, which is now superseded by the Champions, to a great extent.

507. Why did you give the Rocks up?—Because they had not the same immunity from disease as the Champions.

508. On account of the disease?—Yes, on account of the disease.

509. You found the Rocks much more subject to the disease than the Champions?—Yes.

510. Have you ever had the Rocks and Champions growing in the same field, or nearly in the same fields; fields on the same farm?—No, I do not think so.

511. Have any of your neighbours; have you had any opportunity of seeing Rocks, or potatoes of that kind, growing next to Champions?—Yes.

512. In those cases, had the Champions less disease than the Rocks?—Yes.

513. In

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Chairman—continued.

513. In two fields close to each other, on the same farm?—In adjoining fields. I should like to correct that answer, and say I have no doubt but what I have grown Rocks and Champions in the same fields.

514. Were the Rocks more diseased than the Champions?—Yes.

515. The same year?—Yes, decidedly so.

516. Are you quite clear, from your experience in farming, that the resisting power to the disease of the potato depends very much on the kind of potato?—I am; on the kind of potato.

517. And you think then that a careful selection of seed would very much lessen potato disease?—A careful selection of seed, and bringing it from a later to an earlier district, and choosing the varieties most suitable for the climate and the soil, would tend to freedom from disease.

518. Would you expect a great deal of disease if people used the same seed every second year, and in the same field for 20 or 30 years?—Certainly, I should think that the potatoes would degenerate.

519. They would degenerate very much?—Yes.

520. And you would have a very much greater amount of disease?—Certainly you would.

521. Do you think if potatoes are planted one, two, or three years in the same field, even good seed, that it is likely to degenerate?—I should think so.

522. Have you ever planted these Champions in moory, hoggy land?—No; I occupy no such land.

523. Could you tell me what is the greatest per-centage of failure you have had off the Champions within the last 10 years, or as long as you have been planting them?—Comparatively slight; almost entirely free.

524. Have you known much more than 10 per cent. of failure in other kinds of potatoes during the same six or seven years?—Much more.

525. What is the highest you have known in Scotland, in your neighbourhood, in any one field, in the worst part?—I should say 50 per cent.; probably more.

526. And the same year the Champions close to them have been healthy?—Yes.

527. What do you do with the haulms, the stocks in Forfarshire; do you burn them, or put them on the manure heap?—Put them on the manure heap.

528. Do you think, if there is a failure in the potato crop, that putting the stocks on the manure heap contributes to the spreading of the disease?—I would rather not apply them to the potato breadth next year. The precaution is usually taken of not applying them.

529. You apply them to some other crop?—Yes, to some other crop.

530. Do you ever store your potatoes in pits?—I always do.

531. Do you find, practically, that that injures the potatoes in any way as compared with storehouses?—No.

532. You say the Champions are suitable for a cold and wet year, and a cold and wet soil; of course you do not mean that the Champions will have disease in a hot and dry year; do you mean that, or do you mean that they would fall off simply as much as other potatoes?—They seem to thrive best in a wet year; and in a dry year there will be a very few even of the other varieties diseased.

533. Are the Champions actually better in a cold year than in a dry year?—Yes, actually better.

534. Not merely comparatively with the other kinds, but actually better?—They are actually better in a cold, wet, sunless year.

535. Better than in a dry hot year?—Yes, better than in a dry hot year.

536. Have you in your time seen any potatoes grow older and less capable of resisting disease; any particular variety of potato in Forfarshire?—Well, varieties were cultivated 25 or 30 years ago which are not cultivated now.

537. What is the reason of that?—More suitable varieties may have been introduced; and I fancy that those may become weaker and more liable to disease.

538. Do you think it is for that reason that they have become more liable to disease as the varieties grow older?—I believe that some varieties do.

539. You think they grow worse and worse?—With some varieties I think they do.

540. You said you put on potash as a manure?—Yes.

541. And muriate or sulphate of potash?—Yes.

542. You put on three hundredweight of potash?—Yes.

543. Do you know how much potassium there is in that; have you calculated it in that way, or have you calculated it as you buy it, three hundredweight of the muriate or the sulphate?—Yes.

544. Have you found an increase in the yield of the potato crop by applying potash?—I consider so.

545. Have you often sown potatoes with potash?—I have.

546. Do you find a much larger increase when the potash is applied?—I find a yield that far more than compensates for the application.

547. You distinctly find that?—I do.

548. Have you ever tried potash in the form of seaweed; are you near the sea?—No, I am far from the coast

549. Is there any possible legislation or encouragement that you think might be given by Government, that would have any effect in diminishing the spread of the potato disease; have you any suggestion to offer on that point?—I cannot say that I have. It can only be lessened through a judicious change of seed, I believe always from a later to an earlier district, and from the selection of those varieties that are the most suitable for the soil and for the climate.

550. You have got some small tenants in Scotland, and I believe you call them croftsmen?—Yes.

551. Have you got them in your district?—They have almost become extinct.

552. Have you any experience of very small farms of five or six acres in your neighbourhood?—There are one or two such cases in my neighbourhood.

553. Only one or two?—That is all.

554. Then you have practically no information as to how they grow their crops?—Well, all my servants have gardens.

555. They

Chairman—continued.

555. They get, I suppose, their seed and manure from you, so that they would not correspond to the small tenants in Ireland?—No, they do not correspond further than this, that of course their gardens are much more frequently cropped with potatoes than my fields, and I have always considered there is much more disease in gardens so cropped for years, when disease is prevalent, than in the larger fields.

556. Which were more seldom cropped?—Which were more seldom cropped.

557. Did you give them the seed; was the seed the same as yours?—Yes, I fancy so.

558. And the manure the same; as good as yours?—Yes, and much more abundant.

559. On the whole you would say it was as good?—More stimulating, and a much heavier application.

560. So that you would say that the increase of disease in their holdings was due to the frequent cropping of the same field? — Yes, I attribute it to that.

Mr. *Barclay*.

561. And heavier manuring? — And heavier manuring.

Mr. *Stewart*.

562. You think the only remedy to diminish, if possible, the increase of disease is by a careful selection of seed?—I think so.

563. Do you reckon that the climate of Forfarshire is a dry climate?—Yes, a dry climate relatively.

564. Therefore the seed that would do for Forfarshire would not necessarily do for the western part of Scotland?—No, not only in Forfarshire. We have experience of wet seasons which make it correspond to the normal condition of the western part of Scotland.

565. Where do you in Forfarshire generally get your potato seed from?—From a later and a higher district than that in which I farm.

566. Further north?—Further north.

567. Is the quality of land very good generally in Forfarshire?—There are great varieties of land in Forfarshire.

568. At what period of the year do you generally note that the disease manifest itself?—In autumn.

569. What time in the autumn?—Shortly before being raised.

570. Not at an earlier date?—Not at an earlier date.

571. That would be then about the middle of September?—In August, and occasionally later.

572. Have you any view with regard to the effect of electricity in the air affecting the potato?—No, only that I have noticed it very often appears and makes very rapid progress in close, muggy, warm weather.

573. And you can suggest to the Committee no chemical manures which have a preventive tendency upon the disease?—No further than the withholding ammoniacal artificial manures; that is, stimulating manures.

574. Then you do not approve of guano?—No.

575. I suppose you are aware that a large number of potato growers consider that guano is, to a great extent, a preventive of disease by stimulating the growth, and bringing the potato forward to maturity?—I have not heard of that.

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Mr. *Stewart*—continued.

576. You have not heard that view put forward?—No, I have not.

577. You have never tried the action of petroleum, or anything of that character, to smear the potato with, so as to prevent disease?—No.

Sir *Hervey Bruce*.

578. Have you used lime?—I have used lime on parts of my farm, but not to any very large extent.

579. But on the potato crop?—No, never.

580. Then you have no experience of the effect of that?—No.

Chairman.

581. Is the stone there limestone?—No.

Mr. *Macdonald*.

582. You stated to the Member for Forfarshire that you did not think wet land was calculated to promote the healthy rearing of potatoes?—No.

583. Have you turned your attention much, or at all, to the propagation of potatoes from the seed?—No.

584. You stated that your potato seed comes from the north chiefly?—Yes.

585. Do you know the kind of soil that those potatoes are grown in; is it a similar soil to that which you have?—No, it is more like moor land.

586. That is what I am coming to; have you ever known, or have you seen, anything of potatoes grown entirely in peat, wet spongy peat soil?—I have seen potatoes growing under such circumstances.

587. Have you ever seen or known, or heard, of disease in potatoes so grown?—Yes, certainly.

588. You have seen disease in them?—Yes, I have seen disease in them.

589. In potatoes growing entirely in peat?—Entirely in peat.

590. I mean spongy peat or moss?—Well, if it is very spongy it could not bear them; it could not be worked.

591. I quite understand that; but are you aware that in many places those that have turned their attention to propagating potatoes have propagated them entirely in peat soil, and that the best seed comes from that?—I am not aware of that fact.

592. You do not know anything about the cultivation of potatoes in Lanarkshire?—No.

593. Then you know nothing of the planting or the sowing of seed in peat soil as a mode of propagating potatoes free of disease?—I have no knowledge of that.

594. You have never heard of it?—I have never heard of it.

595. The seed that you get from the northern district comes from Aberdeenshire, I suppose?—No, from a higher district in my own neighbourhood.

596. The moor land in your own neighbourhood?—Yes.

597. And the land there is more impregnated with peat than the land you cultivate?—It is more moor land.

598. Then you seem to have grown largely, and you have spoken highly of the Champion potato;

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Mr. *Macdonald*—continued.

potato; what is the condition under which you grow the Champions; is your land wood land or surrounded by timber to any extent, or is it open and free?—An open farm.

599. Do you know anything of growing the Champions on wood lands surrounded by timber?—No; I have no acquaintance with it.

600. Or by the brinks of rivers?—It is cultivated in the county of Forfarshire, adjoining woods and on the borders of streams.

601. Have you any knowledge whether it grows as well in the timber land, if I may use the expression, or in the land surrounded by timber, as it grows in the open land such as you cultivate?—It retains its peculiar characteristics in those cases, I believe.

602. Even there?—Even there.

603. But does it retain its peculiar characteristic there as strictly marked as in the open land?—I understand so.

604. You cannot say from your own knowledge?—I do not farm such land.

605. Then as regards the disease, is there in your experience any time of general attack of disease upon the potatoes?—Not farther than I explained to Mr. Stewart, from the month of August to the time of raising.

606. Have you not seen it earlier than August?—I cannot say that I remember an attack earlier than August, but I have not paid any particular attention to the exact date.

607. Would you be surprised if it appears early, even in the Champion, in Midlothian?—I should be surprised, certainly.

608. You said the Champion is not so good a potato as some of the other potatoes; the Regents, for instance?—In an ordinary year the Champions will not realise the same price for consumption as the Regent variety.

609. In other words, it is more suitable for cattle and pigs, when the good potatoes can be got?—It is remarkably good to eat too, but it is inferior to the Regent, I believe.

610. It does not retain that characteristic known to the old Scottish potato to a large degree, which is called mealy?—Well, it is not a waxy potato.

611. Then you have not turned your attention as to when the attacks may be made on the various classes of potatoes, such as the Prince Regent?—No.

612. The question was put to one of the gentlemen who appeared here on the last occasion, as to whether the Dalmahoy potato was grown in your part of the country. Do you grow the Dalmahoy in your part?—No; I have known of the Dalmahoys being cultivated, but they are not generally cultivated. They are not a favourite variety for my culture; they are, I understand, a much earlier variety, which will be grown probably in the neighbourhood of large towns for early use.

613. There are two causes for a potato being a favourite variety; the first is its being a variety that is freest from disease; that of course would make it a favourite variety, but there is another cause; is that the cause why you think the Dalmahoy is not a favourite variety?—I do not think it is so heavy a cropper as the Regent.

614. Therefore, the favouritism of the potato is not so much on account of its character as a potato, as on account of its not being so heavy a cropper?—No; but it is an earlier potato, and, therefore, more suited for cultivation in the neighbourhood of large towns, where it is desirable to have early potatoes.

615. Have you ever seen the Champion potato entirely free from disease, while other potatoes were attacked?—That may be said to have been practically the case last year, because I mentioned that a most successful and intelligent grower in my neighbourhood delivered 70 tons of Champion potatoes, and he only had 30 cwt. of refuse.

616. Did you follow those to where they were consumed when delivered, or where they were stored?—They were put upon trucks on the railway and sent to the southern markets.

617. For immediate consumption?—For immediate consumption.

616. So that really that was no test as to the character of the potato?—It was a very great test, I think.

Mr. *Barclay.*

619. Had those potatoes been stored?—They had been stored for months.

Mr. *Macdonald.*

620. That would make a difference. How long had they been stored?—Probably five months.

621. Then that would make it a good test. Do you say you have turned your attention to the storing of potatoes. What form do you store your potatoes in?—In pits three to four feet in width, and covered with straw and earth sufficient to protect them against frost.

622. Do you dig your potatoes into the soil, or do you rest your potatoes level with the top of the soil?—No, slightly under the soil.

623. You put them slightly under the surface?—Yes, slightly under the surface.

624. Do you use straw under them?—No, they rest upon the ground.

625. Do you cover them with straw?—Yes.

626. And do you have ventilators in the pits?—The top of the pit, or a small portion of the side of the pit, is left uncovered with earth for a week or two to allow any evaporation of steam that may gather.

627. Do you close it up afterwards?—Yes, entirely afterwards.

626. Hermetically seal it, virtually; at least so far as earth will do it?—Yes.

629. Then in storing potatoes, have you ever used ferns at all?—No, I have used turf.

630. Immediately on the potatoes?—Immediately on the potatoes, and I consider that is the best plan.

631. Then have you ever used furze?—No.

632. Have you ever laid that on the top of the potatoes?—No.

633. But you think that turf is good?—I have used turf successfully.

634. Green or dry?—Green.

635. You have laid that across the pits instead of the straw or above the straw?—Instead of the straw.

636. Are you of opinion that that promotes the health and the maintenance of the vigour of the potato during the winter better than straw?—No, the advantage is that it keeps them probably cleaner; but I would almost as soon use good wheat straw.

637. Your

Mr. *Macdonald*—continued.

637. Your favour for the Champion has something to do with the growth of it, and the plentifulness of the crop as against other varieties, and I believe in your part of the country it is stronger, and resists better the action of disease than any other?—It is more disease resisting.

638. But you have no knowledge of it being planted in woodlands or timberlands?—I have not planted it so myself.

Mr. *Macartney*.

639. In choosing seed for growing do you attach any importance to bringing it from a distance?—I attach importance to bringing it from a later district to an earlier.

640. That is a difference of soil?—A difference of soil and a difference of climate.

641. Would you consider that bringing seed from two or three miles distance where there is a lighter soil and different earth, to your farm, would have the same affect as if you brought it from the same kind of soil 40 or 50 miles distant, or 200 miles distant?—I do not think so.

642. That would make no difference?—No.

643. You attach importance to the change of soil, and to a later district; to a bigger soil and a higher locality.

644. The reason I ask you this question, and I wish to attract some attention to it, is that farmers very often attach great importance to a change of seed and having different seed?—Probably.

645. And they send a long distance to get a different seed. Now do you know whether getting a different kind of potato from a great distance would be more advantageous than getting the same kind of potato grown in a different soil. I mean to say, supposing you have been growing Champions, would you prefer getting a different kind of potato to put into your ground again from a different place and a different soil?—Unquestionably, if I understand you rightly.

646. A different kind of potato, say the Regent, would you prefer growing the next crop of Regents from a different soil or your Champions from a different soil; the same kind of seed?—I prefer the different soil.

647. But putting both together, would you take the Champion as freely as a different kind of potato from a different soil?—Certainly.

646. From your own experience, do you recollect a potato having a very great character and a very large cultivation coming into less repute after a lapse of years?—The Regent variety has been grown by me for 20 years, and I think they are as good now as they were when I began to grow them.

649. I believe there were three different names of Regent potatoes; there was the York Regent, the Kent Regent, and the Dunbar Regent; have you tried all those three?—No; but there is a gentleman here from Dunbar to-day who probably will have had some experience of them.

650. There is another potato that was in very large cultivation at one time in Scotland, the Kemp, did you ever grow that?—No.

Sir *Hervey Bruce*.

651. I think you attached importance to bringing seed from a higher altitude and a lighter ground to a stiffer and lower ground?—Yes.

652. Is the altitude a material factor in the matter, or would it do to bring the potatoes from lighter ground and lower soil to heavier ground and higher soil?—No, I think that the altitude is of importance.

Mr. *Macartney*.

653. Do you consider it of importance to bring the seed from a more severe climate to a milder one?—Certainly.

Sir *Edmund Filmer*.

654. How long have you grown Champions?—Six or seven years.

655. What sort do the cottagers grow about you, as far as you know?—Regents.

656. I suppose in Forfarshire there are lots of potatoes grown?—Yes.

657. Have any potatoes been sent over to Ireland lately from that county, do you know?—Yes; a great quantity.

658. The Regents, if you are successful with them, are far superior to the Champions, I believe, is that so?—I consider them superior.

Mr. *Barclay*.

659. I suppose several thousands of tons of potatoes have gone this year from Forfarshire to Ireland, speaking roughly?—I should fancy so.

660. And most of the Champions in Forfarshire have been bought up for seed to be sent to Ireland?—A great many have.

661. Speaking of climate, do you prefer to bring potatoes from a backward climate to a better one, or from a better climate to a backward one?—From a backward climate to a better one.

662. And from a poor soil to a rich soil, or from a rich soil to a poor one?—From a poor soil to a rich one.

663. There are, I believe, some small farmers in Forfarshire forming from 10 to 20 acres of land?—Yes.

664. Is there any difference between the system of growing potatoes which they pursue, and that which you have described to us?—Many grow potatoes with only two years' pasture instead of my three years, as I explained, and many grow them on the one greencrop shift instead of the two.

665. Substantially the only difference would be that they would be more frequently grown in the same field than you have described to us?—That would be the only difference.

666. There would be no substantial difference in the treatment itself in the cultivation and the manuring, and otherwise?—No.

Chairman.

667. Can you tell me what price the potatoes fetched to growers, which were sent to Ireland, in February and March last, for instance?—I cannot condescend to an exact date, but the highest price I heard of, was 9 *l.* per ton, and I sold myself at 6 *l.* 10 *s.*

668. About this question of altitude. Have you formed any theory as to why the potatoes coming from a considerable altitude should be sounder. Is it the effect of atmospheric pressure or the quality of the soil?—Well, I think that potatoes that are not over-ripened are stronger, and have more generating power than those that have been ripened.

669. Now, suppose this was a country like Ireland,

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Chairman—continued.

Ireland, for example, where there were not many farms; at any rate in some parts of the districts not mountainous, what should the people do there for getting seed?—Plant late.

670. And that would make up for the want of altitude?—It would to a great extent.

671. For seed?—For seed.

672. They should plant late potatoes to be used as seed next year?—Yes.

Mr. *Stewart.*

673. I suppose you find generally that potatoes grown in a mossy soil are the best for seed, and that they are generally freer from disease; that is to say, in new moss land reclaimed?—Yes; in moorland.

674. Do not you find them generally freer from disease than other potatoes?—I should fancy that through not being stimulated they would be.

675. You have had no experience of them?—No; I have had no experience of growing them in moorish land.

Mr. *Round.*

676. Have you had any experience of the "Magnum Bonum" potatoes?—I have not grown them.

Mr. *Barclay.*

677. They are not known in Scotland scarcely, as far as you are aware?—They are grown in Scotland and in Forfarshire. They are a very favourite variety this year, and have given, at least, twice as high a price per ton, as I mentioned just now, for the Champions.

Mr. *Macdonald.*

678. You say you select your seed with care. If you plant late potatoes, in what manner, or how do you select them, so that you could say they are free of disease?—You can only judge from appearance, I fancy.

679. Are you not far more likely to detect disease from the set or the cut potato than you are from the whole potato; that is to say, if you cut up every potato into three or four sets, are you not more likely to detect disease than you are if you plant the whole potato?—Well, they would receive greater examination, certainly, but I do not think it would be of great practical importance.

Mr. CHARLES RINTOUL, called in; and Examined.

Mr. *C. Rintoul.*

Mr. *Barclay.*

680. You farm about 700 acres of land, having one farm in West Lothian and another in East Lothian?—Yes.

681. About how many acres of potatoes do you raise annually?—On the average 150 acres.

Mr. *Macdonald.*

682. Will you name the immediate localities of your farms?—Four and a half miles west of Edinburgh; that is in West Lothian, and within two miles of North Berwick, in East Lothian, both on the coast.

Mr. *Barclay.*

683. In West Lothian you are at Cramond?—Yes.

684. Is there any differences in the character of the soil in West Lothian and East Lothian?—That west of Edinburgh is very free land, and in East Lothian a mixture of clay and loam.

685. At your Cramond farm you grow early potatoes for the Edinburgh market?—Entirely early potatoes.

686. And in East Lothian you grow potatoes more for the general market?—Yes, for the London market.

687. Is the soil dry and thoroughly drained so far as necessary?—Thoroughly drained, every furrow.

688. You would not expect much success in growing potatoes if the land was either wet or not sufficiently drained?—It would not pay to plant them there.

689. You would not expect a remunerative crop?—I would not have any chance of repayment.

690. What is your rotation on the Cramond farm?—Well, say we begin with potatoes, then wheat, turnips, barley, grass, oats. It is just alternately a white and green crop, and if we do not sow down, we have two white crops, that is to say, barley after the wheat.

Mr. Barclay—continued.

691. How many years elapse between two potato crops on the same soil?—They run six or seven years.

692. What is the rotation upon the North Berwick farm?—That is exactly the same as regards rotation.

693. There is an interval of six years there between your potato crops?—Yes, sometimes seven, if we have barley after wheat, which we very frequently have.

694. You begin to prepare the land immediately after harvest by ploughing a deep furrow?—A good strong furrow.

695. And in spring it requires to be stirred, and you begin to plant as early as the weather will permit?—Exactly so, about the beginning of March, on the average, for planting.

696. You adopt two different systems of manuring for the two farms?—Yes.

697. The potato crop at Cramond you farm so as to bring it early into the market?—Yes.

698. And on the North Berwick farm you conform more to the general practice of the country?—Yes, for the late market.

699. What manure do you apply to produce your early potatoes?—For the early potatoes we give 40 tons of horse and cow manure per acre.

700. And any extraneous manure?—Yes, about 10 cwt. and a mixture of nitrogenous and phosphatic manures, superphosphate, guano, and dissolved bones.

701. What do you estimate the cost of your manure at for an acre of those early potatoes at Cramond?—About 36 *l.* all over; the horse and cow manure costs us 10 *s.* a ton, that is 20 *l.*

702. And the extraneous manure about 7 *s.* 6 *d.* a cwt.,

Mr.
C. Rintoul.

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Mr. *Barclay*—continued.

a cwt., I believe?—Yes, making a total of 23 *l.* 15 *s.* an acre for manures.

703. You do not apply so much at North Berwick?—No.

704. What is the amount of manure at the North Berwick farm?—About 30 tons of manure and five cwt. of portables.

705. That would be 7 *l.* an acre less than at Cramond farm?—Yes, about that.

706. Do you think the heavy manure you apply at Cramond calculated to produce the disease?—No, not on an early crop.

707. Why; is it because you hope to have the potatoes ripe and into the market before the season at which the disease usually appears?—Exactly.

708. But if you were to allow them to remain till the usual time, do you think very much manure would be likely to produce the disease?—If the circumstances of the season favoured the disease, but if it was a dry season I could calculate on having them sound.

709. What is the total cost of the early crop at Cramond?—I have calculated on an average about 38 *l.*, including everything; horse work, labour, and working expenses, I can grow them for 38 *l.* on the average per acre.

710. What time do you begin to take up this early potato crop?—On the average of seasons, about the 1st of July.

711. How much do you take off the acre about that time?—From four to five tons.

712. By what time have you got the whole of the early potatoes lifted?—By the middle or end of August.

713. At the end of August, how many tons do you take off the acre?—From 8 to 10 tons.

714. How do you apply the manure on the two farms. In the first place, on Cramond farm?—I prefer putting all the manure in the drills.

715. Both the farm yard and the extraneous manures?—Yes, everything at the root of the potato.

716. You want to stimulate them as much as you possibly can?—Yes.

717. In order to get them early into the market?—Yes, and I work them as much as ever I can with horse and manual labour till they come up; I have never done working them until they close in the drills.

718. Then Cramond farm is more favourably situated for growing early potatoes than the North Berwick one?—Yes; it is low and surrounded with woods, whereas the other is open, and I think that, for early produce, you must have shelter, and for late you must have an open country.

719. How far is your farm from the sea at North Berwick?—Two miles. There is one farm intervenes between mine and the sea.

720. What time do you begin to plant at North Berwick?—By the middle of March.

721. Why do you not begin earlier?—Because the ground is too cold, and it is not necessary that they should be planted any earlier to produce a crop at the season that I take them off. The middle of March is quite soon enough to begin.

722. Are you afraid, if you planted them earlier, there would be considerable risk of their being frosted?—They might be frosted.

Mr. *Barclay*—continued.

723. By what time must you have them planted?—The middle of April, if I can manage it.

724. You expect them to be ripe usually about the beginning of October?—Yes, ready for storing by the 1st of October.

725. What do you consider the average crop on the North Berwick farm?—About eight tons.

726. How do you keep the potatoes after they are lifted out of the land?—In pits about three and a-half feet wide.

727. Covered with wheat straw?—Yes, that is the best.

728. You take care, I suppose, to have the potatoes dry in the pits before you cover them up closely?—You give them a little time open at the top, perhaps three weeks or a month.

729. That is to say, you begin by putting straw over the whole of the potatoes, then covering up about three quarters of the pits towards the top with a certain quantity of earth, you leave the top part of the heap with no earth on the straw, leaving orifices to allow any heated air to escape from the potatoes?—Exactly so.

730. Now what are the kinds of potatoes you grow at the Cramond farm for early potatoes?—Dalmahoys and early Dons.

731. When did the Dalmahoy first become known?—It was introduced the season after the disease carried all the potatoes away; that would be 1847, I think.

732. And it rapidly became popular after that?—Yes.

733. It became generally popular, and was planted throughout Mid-Lothian about the year 1850?—Exactly.

734. How did it first come into notice?—There was a small quantity of potatoes bought in Edinburgh from a seedsman under the name of "American Earlies," which were well known about Edinburgh at that time for planting in gardens. That is the potato.

735. Have they developed into this Dalmahoy potato?—It was very strange that the disease did not destroy them at that time.

736. Did the seed got for this early American variety prove to be the early American variety known at that time?—It was the early American potato. That was where it came from at that time, and that was the name it went under before it got the name of "Dalmahoy."

737. And then the name was changed to Dalmahoy?—Yes, because it was taken to the Dalmahoy estate.

Mr. *Macdonald.*

738. Where it was chiefly cultivated?—Yes, it went to the fields after that; it was only a garden potato before.

739. Did not those seeds really come from Goole?—I could not say with regard to that. It went under the name of "American Early," being used for garden purposes only at that time.

Mr. *Barclay.*

740. Do you know of any change in the character of the Dalmahoy variety in any respects since the year 1850?—None whatever, further than that it is not so pure. It requires selection now to keep it correct.

741. I presume you select your seed every year?

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year?—It would not suit our business planting for early lifting unless thoroughly selected.

742. Do you find in your experience that the Dalmahoy gets mixed up?—Yes.

743. How is that?—Because it is taken to grow for seed upon lands that have grown other potatoes before, and those potatoes are lying in the soil, and the next year in lifting they are mixed up together.

744 Do you not grow your own seed?—I do, but I am speaking generally that if you buy Dalmahoys which have been grown upon land that has grown potatoes before they get mixed with them.

745. They get hybridised with other potatoes?—Other potatoes get mixed with them.

748. Do you always grow your own seed, or do you buy?—I grow my own early seed, but I buy a great many of my late seeds.

747. Do you find this, that you can maintain the Dalmahoy pure simply by selecting the tubers?—Yes. I send it to late districts and then select it there.

748. You occasionally have your seeds from later districts in the country in order to get a change of seed?—I must do that every second year. Every one would be better, but the second year it must be done.

749. This Dalmahoy variety, according to your experience, required heavy forcing by manure?—Yes.

750. If it is not heavily forced it will not give a heavy crop?—No.

751. It requires also good soil?—Yes, light mouldy land.

752. How do you select your seed as a general rule?—After they have passed the hoeing process, I go over the field and observe the tops of them.

753. That is when they are beginning to come into flower?—Or even before that. Some do not come into flower at all.

754. You can detect the difference in the stems if there is any difference?—Early potatoes do not come into flower at all. They only, at the most, produce a small knot.

755. They never reach blossom?—No.

756. You walk along the drills and examine any difference in the appearance of the foliage?—Yes, and take out those that are not the correct sort.

757. Those stems which appear to be different from the Dalmahoy you pull up?—Yes, take them out.

758. Then when they are digging again do you select them?—Yes. Those that I am going to put down for my early lifting I select at the digging time as well.

759. On what principle do you select them, what guides you in the selection?—When they are digging them up we know them from their shapes and their ripeness. If there is a potato that is not early enough we throw it out. We know it from its appearance and from the skin on it.

760. Can you judge of the ripeness of the potato on lifting them, by the skins?—Yes.

761. Then the other variety you depend principally upon for an early potato, is the Early Don?—Yes, I introduced that potato myself.

762. How did you get it?—I got it off the Dalmahoy, a twin potato. There were two growing together, and I broke them apart and planted them separately.

763. And they produced different varieties?—A different variety from the same potato.

764. You picked out those potatoes with the purple streaks which seemed to take your fancy and then planted them, and they have grown into what is now known as the Early Don?—Yes, there is a purple streak on them.

765. The Old Don is a potato which has entirely disappeared?—Yes. That one was a streaked potato, and that is the reason I gave it the name of Don. The Don potato was a late potato, very famous in Scotland before the disease broke out, but the disease cleared it away.

766. And only one or two potatoes remained?—It was in the garden that this Don potato was found.

767. Then you developed this purple-streaked potato. Does it maintain its purple streaks and colour?—It maintains the streaks now, just as it was.

768. On the North Berwick farm what potatoes do you plant?—Regents are our principal crop.

769. How long have the Regents been popular in the country?—Two or three years after the disease cleared the potatoes away it came into use.

770. That is to say, from the year 1850, or thereabouts?—Yes, 1850 or 1652.

771. Do you know of any difference in the character of the potato since then?—No difference except from disease in disease seasons.

772. Taking everything into account, you do not know of any difference in the character or quality, or constitution, of that potato now as compared with what it was 25 years ago?—The only difference is that it does not stand the disease when a disease season comes.

773. Is it more susceptible to disease now than it was 25 years ago?—I think so.

774. Have you any experience of the Champion potato?—Yes.

775. What is your opinion of it?—I think it is well suited for a wet late season, or for a country such as Ireland. I think it would be very well suited for that sort of climate, but for our best districts in Scotland it is not worth much.

776. You would not be disposed to plant the Champion potato on the best potato soil in a good climate?—No. The only thing that recommends it to me is that it is a safe cropper against disease. If we were expecting to have a wet season I would plant it, but if we were expecting to have a dry one I should not plant any.

777. Is it in a dry season as large a cropper at the Regents?—No.

778. Is it a larger cropper in what might be called a wet season than a dry one?—Yes, it grows better in a damp season than in a dry one, and I think it would be a more productive potato than any other we have at present in a wet season.

779. Had you any Champions in the year 1876?—Yes.

780. What was your experience then?—I thought I would never plant them again.

781. Were they diseased?—No.

782. There were but very few tubers diseased?—They were all tops together and strings,

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strings, and little balls at the ends of the strings.

793. The tubers did not form?—They formed at the very end of the season. At the end of the season we had a severe gale of wind, and that blew the tops off, and then they grew to potatoes after that.

794. But there would not be a great crop after that?—No; all second growth and strings.

795. What is your opinion about their eating quality?—They are excellent eating.

786. Grown in good soil?—Excellent; no better quality.

797. Now you have experimented for a good many years in endeavouring to procure new varieties of potatoes?—Since 1849 I have been always growing them.

799. You have grown potatoes from the seed?—Yes.

799. Almost every year since 1949?—Yes.

790. Do you take any special precautions with regard to the plant from which you take the seed?—I select from the best sorts. When you grow from seed you get all sorts; every shape and variety, you may say, that you can imagine. Yes.

791. And that although you take precautions with regard to the plants from which you select the seeds?—Yes. You take them from the best quality of potatoes, such as the Victoria and from some of those American new varieties that have been coming in. I have been cultivating some of them of late, and they produce earlier potatoes than other classes of potatoes.

792. If you take precautions and grow a plant, say of the Victoria variety, by itself separately in the garden and then sow the seed from it, would you expect to get uniform seedlings?—No.

793. Even in such circumstances, keeping the plants from which the seed is grown as separate as possible from other varieties, the result is produce which is various in appearance, quality, and colour?—Exactly so.

794. And form?—Yes; I think the bees during the flowering of the seed inoculate them, and that is the reason there are so many varieties of them.

795. Natural hybridising goes on, which you are unable to prevent?—Exactly.

796. Then after the first year you select the tubers which seem to you the most likely, according to your notions, to give a good quality of potato, a good appearance, and a good crop?—Yes; if you wish to get potatoes of one kind you must take one potato and plant it by itself; if you were to take the produce that grew and planted them again you would not be any further forward; you would have all sorts again.

797. Then you take out, for instance, a single coloured potato, or a potato all white, and a potato all red, and plant each by itself?—Yes, if it has the proper shape about it, and you plant it by itself.

798. Do you expect the whole of the produce to be uniform in colour?—They will be very nearly alike, not quite the same, but they will have something of the like quality about them that you can select again from.

799. If you select for the second time those that are wholly red and those that are wholly white, do you expect that they will be uniform in character?—You will not get them exactly the same until you can out them, and then the produce will be the same.

900. How many years does it require to develope the potato to a sufficient size to cut into sets?—About three years; you can force them earlier, but naturally it would take three years to get a distinct variety of any number fit to grow.

901. How many years selection does it require to develope the potato to its best, according to your experience?—Four years to get one distinct variety.

802. After four years you can, by selection, maintain such potato as a distinct variety?—It only then looses its distinctness by getting mixed up with others in the ground; you can keep it pure after that.

903. The variety becomes impure by natural hybridising?—Yes.

804. Does the cutting of the potato in sets, in your opinion, improve its quality?—Yes.

905. That is your experience?—Yes; both with regard to making a more productive crop, and also a finer class of stuff.

806. Does that experience apply only to seedlings or to field-grown potatoes?—Field-grown potatoes.

907. As well as to seedlings?—Exactly.

909. If you were going to work for a large crop, and also for one of good quality, which I suppose you always do, do you prefer to cut the potatoes which have to be used as seed?—Yes; if I were to plant small ones I could not get them so pure; the small potatoes that have been grown from outs degenerate; it is always among the small you have the bastards, as we call them.

909. The characteristics of the variety are not so distinct in the small potatoes as they are in the large?—No.

910. Then I suppose very frequently during the development disease appears amongst these seedlings?—Exactly the same as amongst others.

911. Do you sometimes find that those potatoes that you fancied most are most subject to disease?—The finest quality of potatoes goes first always in my experience.

912. Are those finest qualities of potatoes the most quickly developed?—I think there is something with regard to there being more starch in them, and flowery matter, and I think the disease is more fatal in a potato of that class, and therefore they go first.

913. The seedling potatoes are inclined to be what is called "waxy"?—Yes.

914. And as they develope they get dry and mealy?—I want to try and get them off the waxy stage as quickly as I can.

915. In order to do so, you are anxious to have potatoes large enough to cut into sets?—Yes.

818. And you find that the dry and mealy potatoes, which you consider the finer qualities, and those you would like to have, are, if anything, more subject to disease than the waxy kind?—I do not know if they are more subject, but the disease always destroys them more than the others.

917. The disease attacks that quality of potato more readily, or it is more fatal, if I might so say, than where it attacks the com-

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moner and less desirable varieties?—Yes, the waxy ones.

818. Now have you any ideas to suggest as to anything that might be done to prevent the disease, or to make the potatoes more able to resist its attacks?—Yes; I think that growing from seed is the most likely way to overcome the disease.

819. It is a long and tedious process, I suppose you find?—Yes.

820. And very slight results, as compared with the labour and trouble of carrying on continually experiments?—Yes; it is not for any person who is not paid for doing the business. There is not likely much to come of it, unless there is some encouragement given to get new varieties.

821. You do not think that the prospects of remuneration from these experiments are likely to induce many people to go on making them?—No; when the farmer wants seed, he just goes to the readiest market to buy it for his purpose.

822. However, it is in getting new varieties of potatoes which we may hope to be, if not altogether disease proof, at least of the quality and character of being able to resist the disease, more than the present varieties, that we may hope for improvement in growing potatoes?—Exactly so. For instance, take the Victoria; that was grown from seed, and the Champion, which was also grown from seed.

823. Who raised the Victoria from seed?—Mr. Paterson, of Dundee.

824. He is dead now, I believe?—Yes.

825. Do you think that some good might be done by the local agricultural societies, or, in the case of Scotland, by the Highland Society, offering inducements, either premiums or prizes, for the growing of new varieties of potatoes?—Yes; I think great good would result from that to the country.

826. You think a good many farmers would try to raise new varieties if there was some encouragement held out by local societies, and especially by the Highland Society in Scotland, which is the largest of the Agricultural Societies in Scotland?—Certainly.

Chairman.

827. On what kind of scale do you grow the seed; do you grow it in a garden, or in large fields?—First I grow it in a small plot; for instance, a piece the size of this table would be plenty to begin with for the first, because you will get out of a very small quantity of seed a very great many varieties of potatoes. You will get sufficient varieties out of a snuff that you might hold in your hand to begin upon.

828. Then do you have several varieties growing together in the same garden or in the same plot?—No, not when I am wishing to get a new variety.

829. Do you sow it quite by itself?—Entirely.

830. You isolate it from all other potatoes as much as possible?—Yes.

831. But you have on your farm and on your establishment several varieties each year, have you not?—Yes, in the field.

832. Does the disease attack one variety of potato more than another?—Yes.

833. And you find that to be so steadily through the course of years?—Yes.

Chairman—continued.

834. That some kinds of potatoes are more liable to disease than others?—Yes.

835. You have no doubt on that point?—No doubt whatever.

838. Do you think, then, that by giving attention to seed that we might lessen the extent of potato failure in a place like Ireland?—Certainly, very much.

837. Have you any experience of small farmers, crofters, or small tenants in your neighbourhood; are there any there?—No, not in our immediate neighbourhood; but about the hill sides we have plenty of them.

838. How do they farm the potatoes, and how do they get their seed?—They get them from the low country, from the like of us. They always prefer coming to the low country for their seed, and we prefer taking our seed from the high country.

839. Then they do not sow the same seed two or three years running; they do not take it off their own farm two or three or five years running?—No; they wish to sell them for seed again, and they only grow them for seed.

840. Do not they grow them for eating purposes?—Very little. They depend on their gardens for eating purposes, which is a finer soil than what they have on their farms. You could scarcely trust them as suitable for food.

841. Then these small farmers are as careful about the seed as the large farmers?—No, they are not so careful, because they are not so aware of the importance of it for their own uses; but if they wish to sell them to a farmer in the low country again they must tell where they get the seed, or give him an opportunity of seeing them before he buys them.

842. Have you seen cases of very bad farming where people have sown the same varieties for 20 or 30 years?—That is very common, where they get seeds of all sorts.

843. Do you find that the potatoes sown in that way are much more exposed to disease than potatoes carefully grown from seed and changed?—No, but they get very degenerated with regard to the variety. They are all varieties if they are not selected, and they will get into no variety at all.

844. When they get into all varieties in that way, does the disease affect them more than it does the special varieties carefully grown; does a larger proportion fail each year?—I do not think there is any difference with regard to whether they are selected or not. It depends very much on the season that the disease is there. If it is a bad season for disease they will take it a little; although they will not take it nearly so bad as we do in the low countries any year.

845. That is in these hills?—Yes, they will not.

846. Then from your last remark, it would seem to me that you find these special varieties which are grown carefully, such as the Champions, do not resist the disease much more than the common potato?—They resist the disease more than the ordinary potato.

847. That is your experience?—Yes; that and the Victoria resist the disease better than any other popular potato that is grown, such as Regents or Dalmahoys.

848. Have you seen instances of that. Have you seen Champions in the same district in a particular year resisting the disease, when the common

Chairman—continued.

common varieties are diseased?—Yes, I have had them growing in the next drill, and I have had the Regents all cut down and the Champions almost untouched growing right alongside in the same field, with the same treatment, the same land, and everything.

849. Have you seen instances of that very often?—Yes, when the disease was prevalent, not in every year.

850. Then you have no doubt in your own mind that special kinds of potatoes like the Champion can be obtained, that will resist the disease?—Yes, from seed.

851. Have you formed any idea in your own mind as to how long a good variety of potato may stay away from seed, and yet resist the disease?—A good many years. Yes; for instance, go back upon the Victoria. The Victoria is getting very much subject to disease now. At first it was as strong a disease-resisting potato as the Champion is now, but now it takes the disease too.

852. How old should you say the Victoria is as a variety?—I think it came out about 1856.

853. You have no doubt it is degenerating now as a disease-resisting potato?—Yes; it is degenerating every year with regard to resisting disease.

854. Now, as to the Regent potato, how long has that been in existence?—Since about 1850.

855. Is that giving way as a disease-resisting potato?—Yes, as disease resisting, but not with regard to quality; it is as good with regard to quality now as ever it was.

858. But more liable to disease?—Yes.

857. Then that is in about 30 years. If you took a potato like the Regent or the Victoria and sowed it every second or third year in the same land, and always stuck to the same land, would you expect that potato to be much more liable to disease than these carefully selected varieties; if you farmed as badly as you can possibly fancy?—If you never shifted the seed from the same farm?

858. Yes, and sowed it in the same land every second or third year?—Yes, it would gradually get more disease according to the season; it would gradually go back.

859. And be much more liable to disease than if you had carefully selected the seed?—And changed it to an upper district. Yes.

860. Do you think it a bad thing to choose the small potatoes always for seed?—Yes.

861. A very bad thing?—A very bad thing.

862. And leads to the potatoes degenerating?—Yes; you get into coarser stuff always if you do not grow it from cuts every alternate year; they would not go back in one or two years, but if you continue growing from small potatoes you will get into a bad stock.

863. If you choose rather small potatoes, not marketable, and set them, would you expect to get bad potatoes in the course of 15 or 20 years with that practice?—Yes, unless the crop was entirely small and never had the chance of growing big; but if you take the small out of the big potatoes you will degenerate your stock.

864. That is the ordinary practice in Ireland?—Exactly, growing from a degenerated kind of produce.

865. That would distinctly injure the potatoes?—Certainly, the same as in live stock.

868. Now you say that growing from the seed is not remunerative work unless there is some encouragement for it?—Yes.

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867. How do you think the Government could encourage the growth of fresh varieties from the seed. Have you any practical suggestion to make?—If they were to pay some person for carrying out experiments in different parts of the kingdom, I think they would come at it.

868. Which would you think best; that they should have places, such as Glasnevin, near Dublin, and grow varieties there, or introduce a system of offering rewards all over the kingdom?—All over the kingdom would be best, and most likely to bring out results that would be beneficial.

869. To offer prizes?—Yes.

870. Could you give me any idea of the sort of scheme the Government could imitate of offering prizes?—I do not know whether offering prizes would be so good as having stations here and there.

871. Government stations?—Yes.

872. Under Government officers?—Partly, or under societies, such as the Highland Society. They might make some arrangement with the Highland Society if they could not do it themselves, or make some arrangement with other societies to see the thing properly carried out.

Mr. *Barclay.*

873. Has the Highland Society done anything in that way hitherto?—No, nothing. They do not go back to the foundation.

Chairman.

874. You think the best way of discovering disease-resisting varieties will be for Government to place money at the disposal of some of those agricultural societies to offer prizes?—Yes; or to have a Minister of Agriculture for themselves.

875. I am afraid that is getting into a big question. Do you think it would be advisable to place money at the disposal of these various agricultural societies?—Yes, I think I should give some contribution, or do it in some way that it would be carried out, and grow from seed apples.

876. How would you know that the potato was disease resisting at the end of the term?—After it had stood such years as 1877 and 1879, I should say it was in a good way for standing for 10 or 12 years after that.

877. Then you would think, if the potato stood a year or two, which were bad years for disease, that it would be a disease-resisting potato?—Yes, for some time; but I do not know if it would resist it always.

Sir *Henry Bruce.*

878. Am I to understand from an answer you gave, that the disease comes on at a particular time of the year, and just at a particular period of the growth of the potato?—It comes on about from the middle of July to the middle of August.

879. No matter what time the potato was planted?—If it is planted very early, it will be a few days earlier on account of that, but generally the disease is produced by the rain that falls between the middle of July and the middle of August; that has been my experience. I can calculate the amount of disease by looking at my

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my rain gauge in the last two weeks in July and the first two weeks in August.

Mr. *Barclay.*

880. What is the difference between the two farms?—The disease displays itself earliest where the potatoes are earlier. I have always found that.

Sir *Hervey Bruce.*

881. I did not gather that from the answer you gave earlier?—Yes. So that I infer from that, that the disease displays itself upon the potato at a certain stage of its growth, when it is just about the ripening stage, or coming towards that. Yes.

882. Then I misunderstood your answer earlier. Do you agree with the last witness as to stimulating manures being bad for potatoes?—Yes, over stimulation by portables; but I do not think that the manuring with horse and cow manure is prejudical, provided that it is not put too near the potatoes, if it is put on the stubble.

883. Do you agree with him in the answer he gave about altitude, that the seed you change ought to come from higher ground to lower, quite irrespective of soil, on account of not being so well ripened?—Certainly, they should not be ripened. They should be from a high district that never ripens a potato properly; that is the best seed to have.

884. Have you ever applied lime at the time of sowing potatoes?—Yes.

885. Do you consider that beneficial to the potato?—No, it is very hurtful in respect of making them scab. It produces scab in the tubers, and does no good with regard to resisting the disease.

Mr. *Earp.*

886. When you are raising fresh plants from seed, how long is it before these fresh plants reach maturity. They are small tubers in the first year's growth?—The first year you get potatoes about the size of sparrow's eggs, or perhaps you may have one about the size of a pigeon's egg, if you have been treating them well.

887. Up to what time do they remain in the ground and exposed to the atmospheric conditions which might probably produce disease. As long as the ordinary potato?—No; I should take them up when the tops began to show ripeness.

888. You do not leave them as long as the ordinary growth?—No.

889. Have you at any season had those seed beds affected by disease?—Yes.

890. So as to lose really the crop of the seed?—Yes, the very first year I have seen them attacked.

891. Would they be attacked in those instances at about the same time that ordinary potatoes were attacked?—Just about the same time. The end of July or the beginning of August.

892. So that although they would not have the same chemical elements, the same starch, and the same properties, still they are liable to the disease?—Perfectly; but not to the same extent as a starchy potato.

893. You have spoken of disease years. In your experience, how often have the disease years occurred, about?—I have grown since the year 1850, and I think I might say that 1855 or 1856 was the first bad year. I can hardly recollect which, but in 1858 and 1857 they were very bad, I think. It began a little in 1855, but it was quite owing to their being an extra wet season that it developed itself so much, in my opinion.

894. In the intermediate years have your crops escaped altogether?—In a dry season sometimes I find touches, and I have seen it on the tops without touching the roots, many times.

895. Would that be in the lower parts of the fields, or in any particular or marked position, which has led to your special observation?—The flat places and retentive sub-soils are always worse, in my experience.

896. And there the exceptional cases occur in good years?—Yes, in the best of years you will see a little there when you will not see it anywhere else.

897. The Champion is a favourite potato of yours, is it not?—No, not for my business; I am growing for the Edinburgh market and the London market entirely.

898. It is not then considered in ordinary seasons the best variety in Scotland?—No, not in good seasons; only in wet ones.

899. Do you notice the same tendency to degenerate in the Champion that you have said you have noticed in the Regent?—Well, I think from the direct experience we have had, that it is getting a little more inclined to disease; I had some disease in it last year.

900. It is beginning to fail a little you think?—Yes, there were a good many diseased ones here and there, and the tops of the potatoes showed it unmistakeably in patches last year.

901. As if in the incipient stage?—Yes, and in 1877, in the same way, there was some disease in my fields.

Mr. *Round.*

902. What sort of year was last year in your country?—It was the worst I have ever seen or known for the last 30 years anywhere.

903. At what time did that disease appear last year with you?—It would be about the beginning of July.

904. When you were first acquainted with this disease did you try to check it in any way?—Yes, I have tried every way I could think of, and I have top-dressed them with several stuffs, flour of brimstone, and different things I have tried.

905. But you have never found any means of checking it?—No, not of checking it; the only thing that checks it is the weather changing.

906. A periodical change of seed and a new seed is the only preventive?—The best preventive, I think.

907. What do you say is the best potato on the whole, in your experience, for you, as being less free from disease?—The Victoria, I think, is the one that has resisted the disease most, and produces the best quality of potato at the same time, that I know of.

908. Have you grown the "Magnum Bonum"?—No; but I know people who have tried it; it is a very bad potato to eat, but it grows a large crop, and is pretty sound I think.

909. You say you do not approve of small potatoes for seed, but do you like the biggest, or have you any particular size you choose?—I prefer well-sized potatoes as being the best for growing

Mr. *Round*—continued.

growing a large crop again, but I oftentimes plant small ones.

Mr. *Barclay.*

910. Were those Champion potatoes which were affected with disease last year, grown after using very stimulating manure?—Just the ordinary; not so much manure as we grow our Regents with; I think they do not require nearly so much manure as Regents or Victorias.

911. Then if you gave them very stimulating manure, you would expect that it would tend to develope the disease more readily in the Champions than if they were cultivated in the usual way?—Well, they would grow too strong, and perhaps not produce any potatoes at all, if I gave them too much manure.

Chairman.

912. Have you ever noticed the difference between growing in lazy beds and drills?—Yes.

913. Do you grow chiefly in drills in Scotland?—Always in drills in Scotland, except in the case of some of the small crofters about the mountain sides, where the land is too damp for drills, and then they would require to put them in a bed to drain them.

914. Then in badly drained land and wet land the lazy beds are the best?—Certainly, the best.

915. Otherwise, do you think the drills better?—Yes.

916. Do they give a better crop, or simply save the labour in digging out?—They are a better crop, and grow a better quality of potato, too.

917. Do you think there is any difference with regard to the existence of disease between the lazy beds and the drills?—I do not think, under the same circumstances, there would be any difference. The lazy beds would, of course, only be grown where necessary, where the land was not drained. You could not drill it at all to grow them to a crop.

918. You were talking of over-stimulating manure; how much manure would you consider over stimulating?—Not too much nitrogen in the manure.

919. How many pounds of nitrogen manure do they require, or how many loads of farm-yard manure?—Three cwt. of Peruvian guano would be plenty, and 5 cwt. of dissolved bones mixed together.

Mr. *Barclay.*

920. You are supposing a considerable quantity of farm-yard manure besides?—A full manuring of farm-yard manure besides; the nitrogen is there too.

Chairman.

921. How much Peruvian guano if you had no farm-yard manure. Have you ever grown in that way?—Yes. I have given as high as 15 cwt. of Peruvian guano as an experiment, to a statute acre.

922. How many per cent. of ammonia in the guano?—There would be about 11 or 12 per cent. of ammonia in the guano.

923. That would be rather high-class guano?—The best. That was about 15 years ago. It is not so good now as it was then.

924. Have you found putting as much as 15 cwt. to the acre answer?—No, it is far too much.

Chairman—continued.

Mr.
C. Rintoul.

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925. What would you say would be about right?—Do you mean entirely with guano?

926. Yes, or guano and potash?—Well, about 10 cwt. of guano and 2 cwt. of potash.

Mr. *Barclay.*

927. And any super-phosphate?—I have answered as to the one alone. I should take less guano in that case.

928. If you had no farm-yard manure what composition of extraneous manure would you think the best to use?—I should say about 15 cwt. all over; but I should mix up 5 cwt. of finest bone meal, 2 cwt. of potash, 3 cwt. of the best guano, and 5 cwt. of super-phosphate, making 15 cwt. altogether.

Mr. *Earp.*

929. In a disease year has it ever been your experience to lift a certain quantity of patatoes before the disease had attacked your fields generally?—Yes, I have tried that.

930. You have done so?—Yes, and they took the disease afterwards, when the disease came.

931. Although they had been pitted?—Yes, or even although they were kept on a floor.

932. Have the tops in those cases shown any symptoms of disease when you have taken them up?—No; sometimes I have taken them up with no disease in them, and it has developed itself just the same, and sometimes I have taken them without any disease in them, and when the disease came it took them away; but not so bad perhaps as it might have been if they had been in the ground.

Mr. *Stewart.*

933. Comparing farm-yard manures and artificial manure, which do you consider produces the most healthy potatoes?—The farm-yard manures, if you were using it entirely. If you wish to compare them, the farm-yard manure would be likely to be soundest; but it would depend on the season very much.

934. As regards quantity, what do you say to that?—The manure made from horses and cows would produce the best crop.

935. Better than the artificial manures?—Yes, taking the same money value, if you are going to money value of the portables and manure, should prefer the manure.

936. Do you suggest anything to the Committee that would, in your opinion, tend to do away with the disease or prevent its extension?—Yes, I think that by growing from seed apples you would be most likely to combat the disease, and get disease-proof potatoes. The real way to prevent disease is to renew the stock.

937. That is your only suggestion to prevent disease?—I have proved that from experience.

938. But you do not know anything that you could suggest to the Committee with regard to the application of chemicals, whether to the tubers or to the foliage; the haulms?—No, I think the variety is the thing; to go to the foundation, it is the variety of the potato you must look to as being likely to combat disease.

939. Have you any distinct views with regard to the age of the potato, that is to say, if the potato has been popular for 10, 15, or 20 years, does, generally speaking, that potato diminish in condition?—I was saying that the Dalmahoy is as good just now as I knew it to be 30 years ago.

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Mr. *Barclay.*

940. And others are not ?—The reason I will give for the Dalmahoy is this ; that it is always grown as an early potato, and it is lifted before the disease comes on.

Mr. *Macdonald.*

941. You have spoken of the character maintained by the Regent potato. Do you know the reason, or can you give any reason, why it has stood the test so well as against other potatoes ?—The only reason I can give is that it has been changed about more to the coast districts. It has been taken up the hills and brought down again constantly.

Mr. *Macdonald*—continued.

942. Do you know anything of the sex of potatoes ?—Yes.

943. Is the Regent a male or a female potato ?—Well, I think as a class, there are both males and females in it, the same as any other.

944. You have not paid any attention to that question ?—Not with regard to its having a distinct sex at the first.

945. The Dalmahoy potato is so named because it was grown on the estate of Dalmahoy ?—Yes, the name was changed from American Early when grown there, on Lord Mortoa's estate.

Mr. WILLIAM RITCHIE, called in ; and Examined.

Mr. *W. Ritchie.*

Mr. *Barclay.*

946. Do you farm about 1,600 acres of land in East Lothian and Peebles-shire ?—Yes

947. How many potatoes do you grow annually ?—From 60 to 100 acres, not always the same quantity ; 60 to 60 acres it may be on an average.

948. What is the general character of the soil on your farm in East Lothian, near Dunbar ?—Red loam.

949 Do you know anything of the sex of potatoes ?—Yes.

Sir *Hervey Bruce.*

950. Is that " Spot Farm" ?—Yes.

Mr. *Barclay.*

951. What is the quality of the soil on the Peebles-shire farm ? — Somewhat gravelly soil mostly. Part of it is poor and moory soil.

952. All dry and well drained ?—Yes, both farms have been drained since I got them.

953. Do you think it is essential for the growing of potatoes that the land should be either naturally dry or well drained ?—Yes.

954. What is your rotation on the Peebles-shire farm ?—Generally pasture two or three years, and then I take potatoes, and turnips after potatoes, because it is a stock farm, and it does not diminish the quantity of turnips for the stock ; then barley after turnips, and then grass for three years.

955. What is the interval between two crops of potatoes in the same field ?—I endeavour to keep the potato crops as far away from each other as possible, simply because I am troubled with finger-and-toe in the turnips there ; I consider potatoes a preventive, and I grow potatoes before turnips. Perhaps it is six, seven, or eight years.

956. And similarly with Spot farm ?—Yes, but the rotation is different.

957. You have heard the evidence of the last witness as to the cultivation of the land for growing, and planting, and lifting potatoes ?—Yes.

958. You pursue very much the same system ?—Just about the same, only I do not grow early potatoes.

959. How much farmyard manure do you apply to the potato crop ?—I apply about 36 to 40 cartloads in East Lothian.

960. That would be about 30 tons ?—Yes ; and I generally take it a year old.

961. How much extraneous manure do you

Mr. *Barclay*—continued.

apply besides the farmyard manure ?—Six or eight hundredweight.

962. Consisting of what ?—Guano and dissolved bones probably ; sometimes a little bone meal.

963. Do you apply potash in any form ?—No, I do not like potash with potatoes.

964. Possibly your soil contains sufficient potash without applying any ?—I do not know, I am sure, but I think potash has a tendency to deteriorate the quality of the potatoes.

965. To make waxy potatoes ?—Yes, to make them watery and waxy.

966. Then as to the seed ; I believe you raise on the Peebles-shire farm the seed which you are going to plant on the Spot farm, in order to have a change of seed ?—Yes ; I grow them principally for seed altogether in Peebles-shire.

967. The Peebles-shire farm is a lighter soil and later climate than the Dunbar farm, Spot farm ?—Yes.

966. Do you think it an advantage to get this seed from the later districts and the poorer soil, to grow in the finer climate and the richer soil ?—Yes, I think it is an advantage to get it from a higher climate ; but if you grow your seed you have an opportunity of getting it more pure in a general way than you can purchase it.

969. What quantity of seed do you use ?—About 12 cwt. to an acre.

970. Do you use the same quantity of seed with all the varieties of potatoes ?—I use more with Victorias, because I generally plant them whole.

971. You use more seed of the Victoria variety, and you prefer to plant the Victorias uncut ?—Yes.

972. Why ?—Because they do not spring so well as the others we think, and there are apt to be more blanks if you cut them than if you plant them whole.

973. The cuts are rather delicate and die ?—Yes, they do not spring so regularly.

974. Have you any idea how much it costs you to produce an acre of potatoes on the Spot farm ?—It costs somewhere between 26 *l.* and 30 *l.*, according to the quantity of manure you give them and the value of the seeds ; that varies very much ; this year it cost 4 *l.* 10 *s.* for seed, and some years it would not cost half of that.

975. Do you object to plant small potatoes ?—Yes, very small potatoes.

976. Do

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Mr. *Barclay*—continued.

976. Do you prefer the medium size?—The potatoes in my district generally go to London, and are dressed through a 1¾-inch riddle, and then I put those potatoes again through a 1-inch riddle, and the medium size we plant.

977. And it is the potatoes that will not go through a 1¾-inch riddle that come to London?—Yes.

978. Do you plant about the same time as Mr. Rintoul does upon the North Berwick farm?—Yes, about the same; I do not grow early potatoes at all.

979. Do you plant as early on the Peeblesshire farm as on the Dunbar farm?—A little later; it is higher climate and subject to frost; generally 14 days later.

980. You do not like your seed potatoes to be fully ripe?—No, I generally take them before they are ripe.

981. What potatoes do you plant?—Principally Regents with a few Victorias, and of course a few Champions.

982. What are the reasons which make you prefer Regents?—Because we think them both the best croppers and the best quality.

983. You get more money out of the land by a crop of Regents than by any other variety, on the whole?—Yes, if it is a good season and we are fortunate.

984 Have you had any experience of the Champion potato?—Not much. I never grew them till last season.

985. Which variety of potato do you consider the best disease resisting or the least affected by disease?—Champions.

986. And next to Champions?—Victorias, I think.

987. And then?—The Regents.

988. What is your opinion of the characteristics of the Champions. In the first place as to the habit of the plant?—I cannot have a great opinion about that, because I have only grown a very few of them. I had only some three acres of them last year. I have a good many this year, but I had only three acres last year for the first time I ever planted them.

989. What sort of crop had you from them in comparison with the Regents?—I had three times the crop of Champions that I had of Regents, but then it was just the year for them.

990. Last year was a year that suited the Champions?—Yes, and a year against all other varieties that we grow.

991. What is the eating quality of the Champions according to your experience last year?—They were very good. Not quite so good as the Regents, but still very good.

992. Do you think the constitution of the Regent potato has become weaker in your experience?—No, I do not think there is. I think it is just the seasons more than anything else.

993. According to your opinion the Regent does not vary in any respect in the reference to habit, quality, or size, from what it was 25 years ago?—Not if you get a favourable season for growing them.

994. Has the Victoria variety shewn any weakness?—Yes, I think it has a little.

995. Is it becoming more susceptible to disease?—I think it is a little.

996. Have you any suggestions to make as to precautions to be taken to prevent disease or to grow healthy potatoes. In the first place, I suppose you think good dry land ought to be selected?—Yes, I think it is foolish to plant potatoes at all in wet land, for I have seen often in a good year where there was a small spot of wet land, that although there would not be disease, they would die away. Besides, they require to be careful in the selection of seed, and of course to get seed from a cold or higher district to a lower warm district.

997. What do you do in order to maintain a good and pure quality of potato?—I buy a few every year of the best and purest I can find for my Peebles shire farm, probably about one-third of what I grow, and then I plant those perhaps a second year and take them to spot, and at spot I plant perhaps two-thirds of them from Peeblesshire, and perhaps a third of our own seedlings that have been grown one year.

998. So you are continuously selecting the potatoes that you are going to use as seed?—Every year.

Chairman.

999. Do you attribute great importance to not growing potatoes too often in the same land?—Yes, I think that you will grow them of a better quality and freer of disease, if you grow them at six or eight years' rotation, than by growing them on the fourth rotation.

1000. How long altogether have you been growing these large quantities of potatoes?—It is 13 years since I took this East Lothian farm.

1001. What is the largest per-centage of failure with potato crop you have got in any one year?—I remember one year I had not a ton an acre.

1002. What per-centage would that be; 80 or 90 per cent.?—About 75 or 80 per cent.

1003. Did you notice whether there was any difference between the different varieties of potatoes, or did all the varieties go?—I had no variety of any consequence but Regents; I had a few Red Bog potatoes, an early potato, for early use, but unfortunately all the Regents I had planted were nearly gone with disease.

1004. And 75 or 80 per cent. of them went?—Yes.

1005. Is it your experience that the Regents are becoming more susceptible to disease than they were originally?—I think they are a little, but there is not so much difference if you have a good year. I have had as good crops of Regents, and as good quality, since we had these very bad seasons of disease as I have ever had before. I think the season has more to do with it than anything else.

1006. But you think there are certain potatoes like Champions which will resist a bad year?—Yes, we fully proved that last year.

1007. Your experience is not confined to your own farm?—No.

1008. Have you seen the farms of your neighbours, and have you seen the Champions doing well there?—Yes.

1009. Have you seen very few cases of disease amongst them?—You will find a potato here and there diseased, but nothing of any consequence.

1010. And close to these Champion potatoes are there other potatoes that have failed altogether, or failed largely?—Yes, and gone altogether in some cases; not one left.

1011. Have you any suggestion to offer to the Committee for the lessening of the disease?—I

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Chairman—continued.

do not know. It would be very difficult. I have tried a great many things and never succeeded in any. I have taken off the tops early, and I have lifted them before they were ripe, and when there did not seem to be any disease to the eye; but whenever the season came that the crop in general took it; even those I had lifted before it was visible took it in the pits.

1012. Have you any experience of small farmers in your part of the country?—There are none in my part of the country; but I have been up in the north of Scotland and I have seen small farms there.

1013. Have you seen anything to correspond with the cotter farmers in Ireland, with five or six acres of land?—Yes, there are plenty of cotters in the north of Scotland who have only a few acres.

1014. Do they change their seed?—They do occasionally, but not very often.

1015. Do they change the land they grow their potatoes in?—Yes, I think they do. When you come to very small cotter farmers I do not think they change their seeds at all because they consume their potatoes, but if you come to a cotter who grows six or eight acres he has to be more careful, because he generally sells them for seed again.

1016. Do those small farmers lose more potatoes from disease than larger farmers?—That is a question I can scarcely answer, but I think they do.

Mr. *Stewart.*

1017. I understand your antidote is change of seed and change of land?—Yes.

1018. That you consider is the only known preventive for the spread of disease?—Yes, and not too much artificial manure. I think a large quantity of artificial manure is an encouragement to disease, and I am trying this year a field without it altogether.

1019. Do you consider the quantity which the last witness spoke of, 15 cwt. per acre, a very large quantity?—Yes, but that is growing without farmyard manure.

1020. With farmyard manure you would not require above half that quantity?—Perhaps 6 or 8 cwt.

1021. And somewhat in the same proportions as the last witness gave the Committee?—Yes, I think his and mine are very near.

1022. These Regents are what are commonly called Dunbar Regents in the London market?—Yes.

1023. You have said that in some years you have only had one ton an acre; what would be considered a good crop in East Lothian?—Six or seven tons of potatoes dressed London size.

1024. Going through a riddle of 1½ inches?—Six to seven tons of potatoes dressed London size, and perhaps a ton to a ton and a half of seconds and refuse.

1025. You say you have tried that plan of cutting out the haulms?—Yes.

1026. But with no great success?—No success at all.

1027. At what time of the growth of the crop did you try it?—Whenever we observed the blight coming on to the leaf of the potato plant.

1028. Of course it would make a great difference when the blight affected the potato, inasmuch as the crop might not be affected till very nearly the time when they were ripened?—I have tried it two ways. On one occasion, I do not recollect the year, but it was a very wet season, and I suspected that the potatoes were likely to take it. I tried a few before there were any signs of the blight at all; and then I tried a few when the blight was showing on the leaf; and in both cases they took disease after the time came that those in the field took it.

1029. And were just as bad as the remainder of the crop?—Perhaps not so bad; but they took disease, there is no doubt about that.

1030. Do you adopt any particular plan with regard to the storing of the potatoes?—Just the usual plan.

1031. To cover up with wheat straw?—Yes, I like wheat straw best.

1032. And ventilated?—Yes, and ventilated, either with straw or with tiles, pipes or drain tiles.

1033. Do you consider that the climate has much to do with this disease?—Yes, there are certain localities in which it is worse than in others.

1034. Would you say that you got more constitution into the potato by importing seed from a totally different climate; for example, from the west coast of Scotland to the east coast of Scotland, and *vice versâ*?—I think when a potato is grown in a higher district and it is poorer land, and perhaps where potatoes have not been for 20 years, that it is hardier than what it is when grown in a lower district, and where potatoes have frequently been grown before.

1035. In my part of Scotland we always consider that Peebles or Lanarkshire seed is the best, that is, in Haddingtonshire; would you say that that could be applied as a general test, to take it from a comparatively dry climate to a comparatively moist climate; would you advise that as a practical man?—I should like seed grown in a dry climate.

1036. Therefore you would say, with regard to Ireland, you would prefer to get your seed from a dry climate, rather than from a moist one?—Yes.

1037. You have never made any experiments with regard to smearing your potatoes, when you plant them, in order to keep off this blight, or insect, or fungus?—No, I do not think it would be of any use, or produce a good result. I never heard of any person who was successful.

Mr. *Round.*

1038. Have you ever tried Magnum Bonum potatoes?—No, I have never grown them.

1039. Have you any experience of the American Ross?—No, I have never grown them.

1040. I suppose you store your potatoes in order to sell for seed?—In Peebles-shire I do, but in East Lothian they go to London.

1041. Did you find that a great proportion turned bad last year?—Yes, there was a great proportion of bad, and a very small crop to begin with.

1042. To what extent were they bad last year?—I was not so unfortunate as some of my neighbours, but I think there would be two-thirds of mine good. Some of them were all bad together, or nearly so.

1043. Do you pick them over after stowing them away?—Not unless late in the season. If they begin to sprout we pick them over; but we

Mr. *Round*—continued.

we do not pick them over unless late in the season.

Mr. *Cross.*

1044. I did not understand whether you were asked the question as to whether you cut your sets; do you cut or divide and set into several? —There are some kinds of potatoes that I should prefer to cut and others that I should not.

1045. Which kind do you think best stands cutting?—Regents, I think.

1046. Do you think they resist disease quite as well if cut? —That is not the principal reason why I prefer cutting them. If you plant small potatoes you have more stems, and it is natural you have more potatoes, but smaller in size than you do with a common sized potato perhaps cut into three sets. You will have one larger stem, and the result will be that the potatoes will be much larger.

1047. I think you stated that you grew a crop of potatoes about every six years?—Yes, six or seven years. Both of my farms are more stock farms; sheep and cattle farms; and I am able to do that better than some others.

1048. Do you think that with a continuous change of seed you might advantageously grow potatoes in your fields year after year?—Well, I should not like to try it. Our ploughmen grow potatoes for 20 or 30 years in their gardens, and in good years they would have a good enough crop, and in a bad year they take disease as well as any others; but at the same time I think they would take disease readier if there were potatoes two or three years in succession, than if the crops were several years apart.

1049. Then do those small growers, with whose operations you are familiar it seems, often change their seed?—Yes, I always give them seed every year.

1050. You encourage that?—Yes, they consume their potatoes, and I always give them seed.

1051. You have not tried any experiments with growing seed from the pod, the plum?—No.

1052. Do you agree with the last witness that there should be some encouragement given to experiment throughout the country?—Or by such

Mr. *Cross*—continued.

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societies as the Highland Society in Scotland; if they were to encourage parties who had had a little experience before, and were to have stations in the different districts of the kingdom, I have no doubt good results would come from it, but I have never had any experience in it myself.

1053. I think you told us that you grow potatoes by preference in front of turnips?—Yes, I have two reasons for that; I require all the green crop break for growing turnips for my stock, and if I grow them after lea I only lose one field of oats, and then I get turnips the following year, which gives the turnip break again, because I think it is a preventative of finger-and-toe disease in turnips.

1054. Of course the fields in which you grow them are not absolutely level; do you notice any difference between those parts of the field that are rather high and those which are low in surface, as to the severity of the attack of the disease?—I always observe that if there is a hollow bit of a field that it is seized first.

1055. Where the moisture drains?—Yes.

1056. That is uniformly your experience?—Yes.

Mr. *Colman.*

1057. Do you recollect the year in which you had this worst crop of one ton per acre?—It was in 1872.

1058. Was it a wet or a dry year?—A wet year.

1059. And you find it worse in wet weather? —Yes, always worst with us. We never have disease in a dry year.

1060. Have you ever tried any artificial manure for growing the potatoes?—Yes.

1061. Have you tried wood ashes?—No, I never did in our part of the country. If you were to apply ashes it would scald the potatoes.

1062. It is used in Lincolnshire, I believe, with very good effect, and the complaint is that they cannot get enough?—I have known people who have used it, and the potatoes always became scabbed, and it did not seem to suit the land at all.

1063. You think it does not suit your soil?—No.

Tuesday, 22nd June 1880.

MEMBERS PRESENT:

Mr. Barclay. Sir Hervey Bruce. Mr. Colman. Mr. Creyke. Mr. Earp. Mr. Evans. Sir Edmund Filmer. Mr. Macartney.	Mr. Macdonald. Mr. Arthur Moore. Lord Moreton. Major Nolan. Mr. Round. Mr. Stewart. Mr. Storer. Mr. Tottenham.

MAJOR NOLAN, IN THE CHAIR.

MR. JAMES ROBERTSON, called in; and Examined.

Mr. *Macartney*.

Mr. *Robertson*.

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1064. You are an active partner in the firm of Hogg & Robertson?—I am.

1065. And largely engaged in the seed and nursery trade in Ireland?—Yes.

1066. Your place of business is Dublin?—Yes.

1067. And you were formerly connected with the firm of Dickson, Hogg, & Robertson?—Mr. Dickson was a partner of mine at one time.

1068 You are a member of the Council of the Royal Agricultural Society of Ireland?—Yes.

1069. And also a member of the Agricultural Committee of the Royal Dublin Society?—Yes.

1070. Have you for many years taken an interest in the agricultural societies in Ireland?—Yes, I have.

1071. And are well acquainted with the general cultivation of the potato in Ireland, as well as in other parts?—Yes.

1072. You have cultivated many varieties at your own residence?—I do have trials at my own residence.

1073. And grow large quantities for the use of your firm?—Yes, we grow large quantities.

1074. Have you ever grown any from the seed?—No, I have not.

1075. But you test the new varieties as they are introduced?—Yes, I do.

1076. Are you acquainted with most of the varieties in cultivation?—Yes, I am.

1077. What are the popular sorts which are grown in Ireland for garden as well as for field purposes, that is, for eating as well as for field purposes?—For garden sorts we have all the usual sorts that are grown, but the popular sorts for field culture are early Kemps. Then we have the White Rock. The Kemps are the second early sort grown for the market.

1078. Then the White Rock?—The White Rock, or Scotch Downs, which is the same thing.

1079. Do you cultivate any long-shaped kidneys, as they are called?—I do for garden purposes.

1080. That is for an early crop?—For an early crop.

1081. Do you consider any of them to be sound potatoes and capable of resisting disease?—All garden sorts of potatoes have been more or less affected with disease, but we do not so much depend upon them as they are generally consumed before the disease sets in.

Mr. *Macartney*—continued.

1082. Do you attribute the liability of what you call garden crops to disease to the delicate and tender nature of the potato, or to their being cultivated in gardens where the change of soil is not so easy as in farms?—No, I think they are of a more tender nature than the field sorts.

1083. And more liable to the disease?—More susceptible to disease.

1084. What potato would you recommend yourself, from your experience, as the best for early cultivation for field purposes?—The Kemp is the potato that has done the best with us for many years.

1085. And for a general crop?—The one that has been in use in Ireland for 20 years is the White Rock.

1086. Do you consider that a potato that is capable of resisting the potato disease?—Oh, no, it has been very much affected with the disease these last few years, especially last year.

1087. But during the early period of its cultivation it was not so much affected?—Oh, no, not at all.

1088. Do you attribute that to any degeneration in the nature of the potato after its being introduced for some time; the potato becoming, from its lengthened use and cultivation, more liable to disease than it was when first introduced?—Yes.

1089. Have you any experience of the Champion potato?—Yes; I introduced the Champion potato into Ireland. Before it was an article of commerce I imported a quantity of it from Scotland, and distributed it throughout Ireland amongst the most practical men I knew, and got testimonials from them in the autumn, which I published.

1090. How long ago was that?—In 1877, I think.

1091. And the testimonials you have received from those to whom you supplied them for cultivation have been generally satisfactory?—Most satisfactory.

1092. Was

Mr Robertson.

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Mr. *Macartney*—continued.

1092. Was the Champion potato, when you introduced it, a rough kind of potato?—Yes, it was a coarse potato, but it is very much fined down since we got it in Ireland.

1093. In using it, after being cooked, was it a good mealy potato?—Yes, it is of the class of floury potatoes.

1094. An abundant cropper?—The most prolific we have.

1095. Would you recommend Champions as the best potato we know at present for general use?—Undoubtedly it is the best we have for Ireland.

1096. Would you attribute much importance to the importing of it from Scotland to grow in Ireland, or would you consider that seed grown in Ireland would be as good to use for cultivation?—For cultivation there is no doubt whatever that the imported seed is the best seed; but we have grown better Champions for food in Ireland than we have been able to get from Scotland.

1097. Can you state whether there is any large quantity of potatoes sold as Champions which are not Champions?—That I do not know.

1098. What do you consider the next best potato for general crop to the Champion at present?—Hitherto the White Rock has been the best, but it has suffered so much from disease lately.

1099. What do you say to the Regent?—The Regent suffered very much from disease too; but the Regent has never been very much grown in Ireland.

1100. Do you know the Skerry Blue?—Yes, the Skerry Blue is an excellent potato.

1101. Do you consider that a hardy potato?—I think it is the one next to the Champion for resisting disease.

1102. Have you tried any American varieties of potatoes?—I have.

1103. Do you recommend them?—No, there is no potato that we have got from America, and we have got most of the sorts, that has done any good in Ireland.

1104. Have you tried any Australian seed?—No, I have not.

1105. Did you ever import any potatoes from England?—Oh, yes. I import most of my garden potatoes from England.

1106. What kinds?—All the classes of Ashleaf kidneys and Flukes.

1107. Do you know the Cumberland Fluke, a very large kind of fluke?—I do not know whether you call it the Cumberland, it is a long kind of kidney of late variety.

1108. Does not the Ashleaf kidney suffer very severely generally from disease?—It is, as a rule, consumed before the disease sets in.

1109. It is the earliest kind, is not it?—It is the earliest sort.

1110. That is a sort that has been very long in cultivation?—Oh, yes, it is a very old potato.

1111. Are you acquainted with an early kind which is also grown largely in Ireland, called the Flounder?—Yes, I know the Flounder.

1112. Do you consider that a good potato?—A very good.

1113. A large cropper?—Yes.

1114. And early?—A second early.

1115. And a good eating quality?—Well, it is not of such good quality as the Kemp potato. The Kemp is floury, and the Flounder is a waxey potato.

1116. Are you in the habit of recommending any particular kind of potato, as a large cropper for feeding pigs, not for eating purposes?—No.

1117. Have you found the Champion potato in your experience improve very much after being in cultivation?—Oh, yes, it has improved very much since it came to Ireland.

1118. Do you consider that the bringing of seed from one country to another, even from the same kind of soil to a similar soil, would be as good as the seed grown in the same country in a different soil and brought to a different soil?—It is of the utmost importance that seed should be changed.

1119. You think change of air and change of climate is good for the potato?—Yes.

1120. Is there any exportation of potatoes from Ireland to Scotland?—Not much to Scotland.

1121. To England?—Yes; to the West of England and Wales there is a large quantity sent over.

1122. For seed?—Yes.

1123. Are you acquainted with the mode of cultivation generally adopted by the small farmers in Ireland?—Yes, the small farmers generally cultivate on what we call the lazy bed system.

1124. Could you describe to the Committee what the lazy bed system is?—Well, the beds are probably about the width of this table, and the potatoes are planted on the tops, about six inches apart, and the soil thrown over them.

1125. With manure?—With manure; farmyard manure, generally.

1126. Then, generally, in the following year, I believe, the lazy-bed is split in the middle, the part which was the middle of the lazy-bed becomes the trench, and they grow a second crop in the same ground?—Yes, that is the system generally adopted by the small farmers.

1127. Are they not also very much in the habit of growing cabbages in the sides of their lazy-beds?—They are.

1128. Do you consider that that detracts from the growing power of the potato, or that it does not interfere with it?—There is no doubt the cabbage must eat up a part of the manure supplied.

1129. Do you think that system is a good one for the small farmers, or would drills be better?—Drills is the best way to cultivate potatoes.

1130. In your cultivation of the Champion, have you found it resist wet well?—Yes.

1131. Would you recommend the growing of it in turf or boggy soil?—Yes, they have come out of an excellent quality both in turf and boggy soil.

1132. But not in wet bog?—Not in very wet bog; but in damp bog they have come out well.

1133. In selecting seed for growing, do you attach any importance to selecting large-sized potatoes?—Yes, I think it is of great importance in selecting potatoes for seed, to get well-matured middle-sized seed, good shapes with the eyes well filled.

1134. Do you approve of cutting up the potato into parts containing eyes?—No; in growing for seed I prefer planting the whole potatoes.

1135. What manure have you found the best in growing for general crop?—I think for all practical

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Mr. *Macartney*—continued.

practical purposes, part farmyard manure, and part super-phosphate, sulphate of potash, and ammonia, or nitrate of soda.

1136. This Committee is appointed to ascertain, if possible, the best means of diminishing the frequency and extent of the potato disease; have you any suggestion to offer to the Committee in that direction?—No, I think it is a matter entirely for individual enterprise; for men such as Mr. Nichol to introduce new sorts, such as the Champion. I think also it is a good field for our agricultural societies to take up; to have potatoes planted in different localities, under different circumstances, with different manures, and with different potatoes, and to have the results periodically published for the benefit of the farmers.

1137. Would you recommend those experiments to be made under the direction of Government officers or by private growers, who are in the habit of growing potatoes?—I think the societies, under practical officers belonging to them, would be the best to do it.

1138. That does not answer my question; the societies, under the direction of their practical officers, doing it, who are to be the growers; I ask the question, whether it should be done by private growers, or whether you think it ought to be done upon Government farms, say?—Well, Government farms, if there are any in existence.

Chairman.

1139. You have said that the White Rocks have been gradually more and more diseased?—Yes, they have.

1140. Do you know anything about the Green Tops?—They are much the same character of potato.

1141. And they also have been getting more and more diseased?—Yes.

1142. From the results of your experience, do you believe that a particular variety of potato wears out after a certain time, after 20 years or so?—Yes, I am of opinion that a potato wears out, and wears out faster from bad cultivation and bad management.

1143. But do you believe that with any cultivation a potato will wear out in a certain time?—Well, we have the Regent potato, for example, which is probably 40 years old or more, at least I remember it ever since I was a boy, and we have it still in existence. It has suffered from disease this last year or two, but not much more than any other sort.

1144. Then as far as your experience goes, do you reject that theory that a variety wears out after a certain time, or do you believe it?—I believe they do wear out.

1145. You say the change of seed is very valuable?—Yes.

1146. How, practically, do you change your seed in your locality?—Do you mean personally myself?

1147. Yes, and your immediate neighbours?—For market purposes amongst the farmers in my district (which is the county of Dublin), where they grow them largely for sale in the Dublin market, they import Kemps from Scotland every year, and those potatoes, of course, are all sold in the market for food purposes.

1148. Are there any large growers of potatoes in the county of Dublin?—Yes.

1149. How many statute acres should you

Chairman—continued.

say?—There are men in the county of Dublin with from 50 to 100 statute acres of potatoes.

1150. Do these class of men never keep over their seed from one year to another?—I think very seldom.

1151. Get it generally from Scotland?—Generally imported.

1152. Have you seen much of the cottier system of tillage in Ireland?—Yes, I have seen a good deal of that.

1153. What is their general system?—What they do is that they send the large seed to the market for sale, and they plant the small ones.

1154. Do they change the seed in the course of 20 years, do you think?—They change it very seldom.

1155. Do you find that the small cottier tenants have more disease than large growers in the county of Dublin?—Yes.

1156. Perceptibly more?—Yes.

1157. Have you any idea of how it would be possible to induce these cottiers or small farmers to change their seeds?—No, I do not know how to do it, unless in the same way as it has been done this year. The Bill that we got for Ireland has been of immense advantage to the tenant farmers, and they have been able this year to get seed in a way they never did before.

1158. But if they are obliged to pay for the seed, do you think they will purchase the seed again?—I think it is very questionable.

1159. Is there any practicable way that you see of inducing them to change their seed?—No, there is not.

1160. You think they will go on the old plan of selling the large potato, eating the middle ones, and sowing the small?—I fear they will.

1161. How do you store the potatoes in the county of Dublin?—There are not many stored in the county of Dublin; they are generally sold for market purposes.

1162. What per-centage of potatoes are diseased in the county of Dublin?—Of the Kemp potato, which is the early potato, and our prevailing market potato there are hundreds of acres that would not pay for taking them out of the ground. I, myself, had one acre of Kemps; I was trying the various sorts of manures, and after a severe storm of lightning they were all cut down.

1163. What is the greatest per-centage of Champions that you have known destroyed belonging to one grower; I suppose you know several?—I know many growers; the per-centage has been very small.

1164. Have you heard of any case of 10 per cent. of Champions having been diseased last year?—No; I do not think in all Ireland there was 10 per cent. of Champions diseased.

1165. Have you any idea as to how the disease spreads; have you formed any opinion about that?—No, I have not.

1166. You say that no American kind of potato has done well in Ireland?—No.

1167. Have you known any Nova Scotian potatoes planted and tried?—No, I have not.

1168. Have you ever heard of any German potatoes being brought to Ireland and tried there?—Yes; there was a large quantity this year.

1169. How have they answered, do you know?—They were only planted this year, therefore we cannot tell.

1170. Was

Mr. *Robertson.*

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Chairman—continued.

1170. Was there a large amount planted or given out under the Seeds Act of this year?—Not a very large quantity; there were some 200 or 300 tons.

Mr. *Tottenham.*

1171. Who, within your knowledge, is the largest grower of potatoes about Dublin?—There is a gentleman of the name of O'Malloy, and there are the O'Neills.

1172. What sort of acreage would either of those gentlemen plant with potatoes?—Well, I should think they would have from 50 to 100 acres a-piece.

1173. Do you happen to know what kinds they planted mostly last year?—Mostly Champions last year.

1174. Have you seen the crops that they dug or the results of the crops?—I have seen many Champions taken up in the county of Dublin.

1175. But in those particular two cases that you spoke of?—No, not on those particular farms.

1176. Do you know Mr. Mowbray?—I do, well.

1177. Are you aware that he had a considerable quantity of Champions sown?—Yes, I am.

1178. Do you know his farm?—Yes, I do.

1179. Have you had any conversation with him upon the subject of his crop of last year?—Yes, I have.

1180. What was the result of his Champions?—Well, I do not remember just now; but he had a large yield of Champions, I think about eight tons per statute acre.

1181. Would you call that a large crop for Champions?—Yes, that would be a fair crop.

1182. Do you know what per-centage of disease Mr. Mowbray's crop may have had?—I do not know exactly, but he told me it was very small.

1183. You said just now that your particular crop was affected immediately after a storm of thunder and lightning?—Yes.

1184. Was that accompanied by rain or not?—No, there was no rain.

1185. Was there any rain about the same time?—Rain was falling throughout the country.

1186. Was it what you call wet weather, or what?—It was moist weather.

1187. Have you ever observed before, that the disease is very often first noticed after a thunder and lightning storm?—Oh, yes.

1188. It is not more frequently so than otherwise?—Yes.

1189. Whether accompanied by rain or not?—Yes.

1190. On the whole, do you think as far as you have seen at present, that the Champion potato is the best for planting purposes?—Beyond all doubt, for Ireland.

1191. Do you know the Magnum Bonum?—Yes, I do.

1192. What would you think of it in comparison with the Champion?—Well, the Magnum Bonum is a good disease-resisting potato, but it is much coarser in quality as a table potato.

1193. But is it within your knowledge that it is less liable or more liable to disease than the Champion?—Well, I do not think there is very much difference as regards that between the two.

1194. But on the whole, you have no doubt that the Champion is the potato for planting, as far as you know?—None whatever.

Mr. Tottenham—continued.

1195. You have no doubt seen last spring a large quantity of potatoes passing through Dublin for the purpose of seed under the "Seeds Act," and otherwise?—Yes.

1196. Do you believe that there was any considerable quantity of spurious seed; not the true Champions introduced?—That I do not know.

1197. An experienced man, or even a practically inexperienced man, can tell the Champion potato before it sprouts, can he not?—Yes.

1198. And after it sprouts you can tell it by the colour of the bud?—Yes, there is a difference in the colour of the bud.

1199. As far as you have seen would you suppose that all the seed, or the great majority of the seed, which was imported in Ireland, was true to name?—Yes, there has been an immense quantity come into the country that is perfectly true to name.

1200. Do you suppose that any quantity of what came in as Champions was really not Champion seed?—Well I have not had any experience of that myself.

1201. No instances came under your notice?—No.

Mr. *Evans.*

1202. What kind of land is yours?—My land is good strong soil.

1203. Is it suitable for potatoes?—Very suitable.

1204. What interval do you think there should be between crops of potatoes?—I think the best potatoes are grown on the fourth and fifth course shift.

1205. Once in five years?—Yes.

1206. You mentioned, I think, that the cottiers had more disease than the large farmers?—Yes, they have.

1207. And I think you gave us the reason that they did not change their seed sufficiently often?—Yes.

1208. Do you think that another reason is, that they grow potatoes too frequently on the same land?—No doubt they do.

1209. Do you consider it dangerous to make use of the refuse of potatoes for the purpose of manure or anything of that kind?—Yes, I do.

1210. Do you think it should be burnt?—Yes, the stalks should be got rid of where diseased is feared.

1211. And you would not even recommend that it should be used on other land than potato land in the same neighbourhood?—No, I would not; although at the same time I may mention that Dr. Lawes is carrying out a series of experiments just now, for which purpose I sent him some potatoes; and he has been doing it for four years; he has been ploughing in the stalks every year into the land, and it has not had any injurious effect to him.

1212. You say, I understand, that in your judgment, after a certain period of time the potato seems to wear out?—Yes.

1213. Do you think that can be prevented, or very much diminished by changing the land?—I think it can be very much diminished by changing the land and changing the potatoes.

1214. Then you would, I suppose, be of opinion that it is a good thing that experiments should be made for obtaining new kinds?—There is no doubt about that.

1215. I understand

Mr. *Robertson.*

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Mr. *Stewart.*

1215. I understand you to say, in answer to the question by the last honourable Member, that the five course shift was the best?—The fourth or fifth.

1216. But I suppose you would prefer if you could make it a much longer course shift?—Yes; if I wanted to grow potatoes for seed I should try to put them in a piece of ground that had not been broken up in the memory of man.

1217. Do you yourself cultivate potatoes in that way, by breaking it up from the grass?—No, but I get people to grow potatoes for me in that way.

1218. And in getting fresh seed do you study to go to different climates?—Yes.

1219. Why do you go to Scotland?—Because experience has shown us that the best change of land that we can get for Ireland is to go to Scotland.

1220. Any particular part of Scotland, the east or the west coast?—No, I think I have got them good from all parts.

1221. And do you find those growing in the western and southern parts of Scotland as good as the others?—I have got as good potatoes from the Tweed side on the east cost as any other district.

1222. Of course in changing seed so frequently as you say ought to be done, there is a considerable amount of expense attached to it?—Not so very much expense.

1223. Does not the fear of the expense deter the smaller tenant farmer from changing the seed?—I think not; it should not do.

1224. Is it not the fact that very few of the small cottiers do change their seed often?—They do not change their seed, but I do not think it is the expense that is the cause of that.

1225. Then what is the reason why they do not change their seed often?—Well, I do not know; I think it is more habit and repute than anything else.

1226. What quantity of the artificial manure, which you named to the Committee just now, do you put to the statute acre; you named three kinds, sulphate of potash, nitrate of soda, and ammonia?—My mode of cultivating my own potatoes is by putting about 14 tons of farmyard manure per statute acre; 3 cwt. of super-phosphate, 400 lbs. of nitrate of soda, and 200 lbs. of sulphate of potash.

1227. And do you find that you have a healthier crop of potatoes by only using farmyard manure, or by only using the manures of the character you have described; or by using a mixture?—My own experience, combined with the information I have derived from the best growers I know, is that the mixture I have given now is better both as regards quality and quantity.

1228. Can you detect any greater freedom from disease in the one case than in the other?—I have never gone into it so minutely as that.

1229. Then do I understand you to say, you would rather grow quality than quantity?—Both.

1230. But I mean quality with reference to disease. You would rather have quality in the soundness of the potato?—Yes, of course; quality is a very strong element with the man who is growing potatoes.

1231. Do you consider that there is more freedom from disease by using the mixture which you advocate, and also that you get a larger bulk of crop?—I think you get both quality and quantity.

1232. Then the only remedy, as I understand, that you consider availe to prevent the further expansion of disease, and to diminish its frequency, is a change of seed?—Change of seed, and getting the new varieties introduced, such as the Champion.

1233. With regard to the Champion seed, is it not the fact that the Champion potato is found much more suitable for a moist climate than a dry climate?—Yes, it is.

1234. And last year was an unusually wet season?—It was.

1235. Have you had any experience of its growth in any large quantities in a dry season?—Yes, the year before, although a dry season, the Champion produced more in quantity than they did even in the wet season of last year.

Mr. *Earp.*

1236. I suppose when you say that the Champion is suitable to a wet season, you mean it is in comparison with other potatoes only?—Yes.

Lord *Moreton.*

1237. Do you think the Champion shows greater liability to disease since its introduction in 1877?—Last year there certainly were more diseased ones than in previous years, but that, of course, would be accounted for owing to the very wet season.

Mr. *Macdonald.*

1238. What is the class of land that you cultivate potatoes on most?—I have seen potatoes cultivated on all classes of soils.

1239. Have you seen them cultivated near timber, and by water courses?—Yes.

1240. And has the same freedom from disease that you have noticed in the open land been observable near timber, and also near water?—Near water. I do not know there was much difference; but growing in what we call woodlands having a strong robust nature; the stalks grow very large, and in consequence of that, if they do not get air, the stalks are drawn up instead of letting the tubers get perfectly formed.

1241. Is the result of growing in woodland that the tuber becomes stringy rather than a full-grown tuber?—No, I did not find that.

1242. You say that you prefer getting your seed from Scotland, as being the best; have you ever seen potatoes grow upon moss land exclusively for the produce of seed?—Yes, there is a large quantity in Ireland grown in that way; upon what we call bog land.

1243. But that land is not quite so bad as the moss land in Scotland; do you know the moss land?—Yes.

1244. Have you seen potatoes grown upon pure peat soil?—Lots of them.

1245. What is your experience of growing potatoes for seed upon the pure peat land?—When we can get potatoes grown upon what we call "reclaimed bog," and then send them to a higher altitude and into stiffer clay, they produce the very best quality of potatoes.

1246. That is your experience?—Yes, upon newly reclaimed bog land.

1247. And

Mr. *Macdonald*—continued.

1247. And then carried to a higher altitude, upon totally different land?—Yes; the result is that the potato is greatly improved.

1248. Do you get the best form of potato then? —You get the best shaped potato, and the best quality.

1249. And the greater freedom from disease? —Yes.

1250. You have bad experience in growing Champions on wood land; would you say there was five per cent. more disease upon wood lands with the Champions, or could you name the percentage?—I cannot name the per-centage; but, speaking generally, I should think there would be from five to eight per cent. more; because, as I said before, the Champion is a potato that wants perfect air, owing to its strong haulm.

1251. And unless it has air, the strong growth of the tubers leads to a deformed and inferior potato?—Not to a deformed potato; but you will have them smaller and less quantity.

1252. You say the Magnum Bonum is a coarser potato?—It is. They are two classes of potatoes, in fact; the Champion is a flowery sort of potato, like a ball of flower when it is boiled; the Magnum Bonum is a waxy potato, and waxy potatoes do not do so well in a wet climate like Ireland as flowery potatoes.

1253. Does the Magnum Bonum, in a dry soil, not produce equally with the Champions, and at the same time produce the flesh of the potato of a fair quality?—No doubt it is an excellent potato.

1254. As regards chemical manures (we will take that designation for all that you mentioned, except the farmyard manure), I think you said to the honourable Member for Wigton that they grow better in quality; are you of opinion that the chemical manures also grow a potato better in quality?—Yes.

1255. It increases the value of the potato as regards produce, and it also increases its value as regards usefulness and quality?—That is my experience after many years' observation.

1256. Were you conversant with the growing of potatoes prior to the time of the failure of the crop?—Yes; I have been brought up amongst potatoes all my life.

1257. Without asking you any questions as to your age, I wanted to know whether you were conversant with thegrowing of potatoes prior to the year 1846?—No.

1258. Is there not a common belief among growers that the use of Champions, such as you have referred to, has, to a large degree, depreciated the strength and vigour of the potato, upon the whole?—No, I think not; on the contrary.

1259. I understand that your opinion is, that the potato has been fortified and strengthened, rather than deteriorated?—Yes. I have letters in my pocket at this moment from the best growers in my native district (the Tweed side), which tell me that that is their experience: and I may mention to you that the way they do it is this: probably they have a crop of potatoes after oats we will say; then the stubble is ploughed up in the autumn, and farmyard manure is ploughed in; then the land is thoroughly ploughed during the winter, and the artificial manures are applied in the spring.

1260. To quicken and strengthen the growth? —To quicken the growth, of course; ammonia quickens the growth of the potato.

1261. Now, about the lazy bed; is it because of want of proper cultivation of the lazy bed by the small growers, that the disease appears there, or is it, do you think, the fault of the lazy-bed system altogether?—I think the disease appears there owing to the continual growing of potatoes on the same ground, and of the same class of potato without changing the seed.

Mr. *Robertson.*

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Mr. *Macdonald*—continued.

1262. Then it is not due to the lazy-bed system?—I think not. I think in a wet year the lazy-bed system is a very good plan, because the water runs away into the furrows or trenches, and keeps the potato dry.

1263. The lazy bed you have seen adopted is with the turf on the level, not sunk or dug down in any way?—No, the beds are raised.

1264. You would have no preference for the drills over the lazy-bed system?—Yes, I would. There is no system so well adapted for cleaning and cultivating land as drills, and of course that is an element in farming.

1265. So that really you prefer the drill both as to cleaning the land, and as to invigorating and making strong the potato?—Yes.

1266. And, looking at it from that point of view alone, you would abolish the lazy-bed system?—From that point of view I would, but then you see the small farmers in Ireland have only spade labour; they have no horses to go and make the drills, and consequently they are obliged to use spade labour, and it is easier to work on the lazy-bed system with the spade.

1267. Have you heard an opinion expressed by small farmers that the cabbage prevents disease, by planting it along with the potatoes?—I have no experience.

1266. You have heard that opinion expressed? —No.

Mr. *Arthur Moore.*

1269. Where you found disease, I think you said you thought it very wise to burn any stalks that may remain after the disease?—Yes.

1270. Supposing a man brings in a load of potatoes half bad and half good, would you think it very important that he should destroy the bad ones?—Yes; I always do so myself.

1271. How?—I burn them.

1272 Would it do to rot them with lime in your doing that?—No, it is better to burn them.

1273. Both the stalks and the bad potatoes? —Yes.

1274. With regard to the sowing potatoes, are you in favour of cutting the potato, or would you put a whole potato into the land?—As I said before, in growing potatoes for seed I plant them whole; but in growing for food I cut them.

1275. You are very much against the very small ones, the refuse; you think that is partially the cause of the disease?—I am not so sure about that. I have had as good crops from small ones as from large ones.

1276. I think you said no American potato seeds have thriven well in your experience in Ireland?—Not that I am aware of.

1277. Have you heard of Breeze's prolific potato?—It has not done well in Ireland at all.

Mr. *Round.*

1278. Was last year the worst year for disease? —Yes.

1279. Do you attribute that to the wet?—To the wet weather.

1280. How early do you put in your potatoes in Dublin?—For market purposes, if the weather is good, they are generally planted in January.

Mr. *Robertson.*

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Mr. *Round*—continued.

1281. You are not afraid of frost there?—We never have the frost so severe in Dublin, at least not frequently.

1282. And you plant early sorts to get them up?—Yes, for market purposes.

Mr. *Creyke.*

1283. Have you ever planted any peat charcoal or any other kind of charcoal with the seed of potatoes?—No.

1284. Do you think that would have any effect in preventing the disease?—I have had no experience in that.

Mr. *Macartney.*

1285. With regard to the lazy bed; would not you think that in growing potatoes in new peat soil for the first time, the lazy bed would be as good as any other system?—The best way.

Mr. *Storer.*

1286. Can you say, from your own knowledge, that you are acquainted with any mode of cultivation or any manure which would be in any degree a specific against the disease?—No, I am not.

Chairman.

1287. You said you burned the diseased potatoes. Are not they used for food by the cottier servants for their pigs?—To a large extent they are.

1288. Is there any harm in that practice?—No.

Mr. *Evans.*

1289. Do you use lime much amongst your potatoes?—Yes; I sometimes sprinkle lime over the cut sets.

1290. Do you find that a useful thing?—I did not find any difference from that.

Chairman.

1291. Is yours a limestone soil?—Yes.

1292. There is a good deal of limestone soil in the county of Dublin?—Yes.

Mr. *Macartney.*

1293. Do you think that the system of pitting is a good one, or would you prefer housing?—There is no doubt that the system of pitting potatoes for food is the best, but for seed purposes I should be disposed to keep them in a house.

Mr. *Arthur Moore.*

1294. As regards the burning of potatoes, it is those pieces of rotten potato which are simply useless for food, even for pigs, which I suppose you would burn, and not allow to lie about?—The small farmers, as a rule, get them used up for pigs.

1295. But you think there is danger, if they are not used in that way, from leaving any portions of them rotting about the field?—I think there is a great danger of their carrying disease for the next crop.

Mr. *Macdonald.*

1296. Going back to the question of planting, you say you like the small potatoes rather than the cut potatoes; do you not think that in cutting up the potato the experienced eye is more likely to detect disease than taking the whole potato?—Well, of course, there is something in that; but at the same time an experienced eye can almost always detect any disease upon a tuber.

1297. That is an important point; do you think that the experienced eye can at all times detect the potato disease upon a tuber?—I think an experienced eye can do so.

1298. Does it always produce, in your experience, such a condition of the epidermis or skin of the potato as makes it easily seen?—Yes.

1299. It does not lodge within the epidermis to that extent which prevents it from being seen?—You can see it from the outside of the skin.

1300. Looking at it in that light merely, would you say that the disease proceeded from the outside of the potato rather than from the inside of the potato?—That I am not quite certain about.

1301. Now, in cutting the potato, is it not your experience that the disease lies upon the external portion of the potato rather than the internal?—Yes.

1302. But you are not quite sure that it may not come outwards?—No, I am not certain of that.

Mr. *Round.*

1303. In consequence of the greater moisture of the climate of Ireland, do you find the disease manifests itself earlier in the year in Ireland than elsewhere?—Last year it commenced about the third week in July, I think, after the storm of lightning that I mentioned before, and all the early potatoes in my district were affected in one night.

1304. You do not find it in May or June?—Not with the early sorts; but you do with the later sorts.

Mr. John May, called in; and Examined.

Mr. *May.*

Chairman.

1305. I believe you are a large grower of potatoes?—Yes.

1306. Could you tell the Committee about what quantity you grow in each year?—I grow from 150 to 200 acres a year; say an average of 175 acres.

1307. Where do you grow these potatoes?—Farningham, in Kent.

1308. What class of land do you grow the potatoes on?—Strong good land, with a chalk subsoil.

1309. Of course you are not very much troubled with wet on the chalk subsoil?—No.

Chairman—continued.

1310. Last year in the very wet weather, was your land too wet?—Yes.

1311. Had you much disease last year?—No.

1312. What per-centage should you say?—Perhaps 8 per cent.

1313. Then you practically consider you had no disease last year?—That was in some sorts.

1314. What were the varieties of potatoes that you grew last year?—Principally I grew Champions.

1315. When did you first grow Champions?—In 1877.

1316. Did

Chairman—continued.

Mr. *May*.

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1316. Did you only grow a small amount in 1877?—No, I grew 120 acres.

1317. What other kind did you grow last year besides Champions?—I had a few Victorias and a few Regents.

1318. Which had most disease, Victorias, Regents, or Champions?—The Regents and Victorias were nearly all bad, and worth scarcely anything.

1319. And your Champions were very little affected by the disease?—Very little indeed.

1320. So that you would be inclined to say that, as far as we have gone yet, the Champions have resisted disease?—Yes, decidedly.

1321. Now, do you get fresh Champion seed each year?—No.

1322. Do you know your own seed from year to year?—Yes.

1323. Since 1877?—No, I get some fresh seed every year. I consider they do best with us growing our own two or three years, but I like to have fresh seed. I get some every year, but I do not like to keep them much longer than three years.

1324. Have you more than one variety of land on your farm, and do you change the potatoes from one variety of land to the other?—We have a little, but not much variety. There is a variety. Some are lighter, and some heavier.

1325. How long is it after one potato crop before you put another potato crop in the same land?—About five years.

1326. Where do you get your Champion seed from when you get it?—I know the origin of these Champion potatoes, and I had watched them for years before. I am in the habit of going to Scotland almost every year, and I knew the man who grew them, and I watched them and took notice of the growth of them for several years before I planted them, and the year I decided to plant them I bought two or three cargoes of them and distributed them amongst myself and neighbours.

1327. Are you in the habit of watching new sorts of potato seeds?—Yes.

1328. You consider that part of your business?—Yes.

1329. You say you knew the man who grew the Champions first. How did you get acquainted with the Champion seed; did you hear of it at shows?—The man that raised them raised them from seed.

1330. Who was the gentleman?—A Mr. Nicoll; he is gardener at Arbroath Cemetery, or was 12 months ago.

1331. You watched his experiments?—I did not watch his experiments, but simply from seeing the growth of the potato yearly when I was down there; I was generally there in the month of September or October.

1332. Did you remark that the Champion potatoes were unaffected by disease?—I did. I remarked that they were always sound and others nearly all bad in many instances, or in some years when the others were half bad or three parts bad.

1333. Have nearly all the Champions you have known been good in every part of the country?—I think so, as far as I know, all over the United Kingdom. I should say from the experience I have had, and I have very good means of knowing, that all over the United Kingdom last year, with the extreme wet that there was, there were certainly not more than 3 per cent. bad. There may have been some low situations or wet places, where they have been possibly very bad, but in an open situation where they were properly cultivated, the outside would be 3 per cent.

Chairman—continued.

1334. Do you believe the cultivation of the potato has very much to do with its getting the disease, or is it the variety of the potato?—I believe it is more the variety.

1335. And it has not much to do with the manner in which you manure it, or sow it?—No, I think that has very little to do with it.

1336. Do you believe in the theory that has been stated, that a variety of potato degenerates after a certain number of years?—Yes, certainly.

1337. Has that been the result of your own experience?—Yes. I can recollect potatoes 50 years ago that are now quite out. When the disease first took place in 1845, all the old sorts that had been in existence for a good many years seemed to totally perish. I recollect the Regent when it first came out, and that potato kept equally as good as the Champion does at the present time for a number of years, and it got distributed all over the United Kingdom.

1338. Then you believe the Champion, after 20 years, or after a certain time, will probably die out?—I believe every year it will keep getting a little worse. I think it will improve in quality, but I think it will be liable to go diseased almost every year.

1339. Do you think for a good many years to come it will be very hardy?—I could not say. I am disposed to think it is not a very lasting potato; but still that is a thing which I cannot tell.

1340. Do you think that for eight or ten years longer it may be a good sound potato?—I think so.

1341. Is there any plan by which the Government could assist in creating new varieties, or should it be left to private enterprise?—Certainly, I have always thought so, and I have stated so publicly, that it is not a farmer's business. A farmer cannot attend to it. I think they should be raised from seed, and that there ought to be some prize, or something of that kind, given, either by Government or by the large agricultural societies for raising fresh varieties from seed. There is a proper way to start upon that. All varieties do not grow seed. That is the plum from which the seed comes. With the Regent you never get any seed, because they never grow any. If you were to get different varieties from which you could get the seed and plant them side by side in a rather warmish climate, such, for instance, as in the southern counties, where there are plenty of bees, you would get them inoculated. Then get the seed sown. After those have grown the first year you get very small potatoes, not much bigger than peas or beans, and the second year you get them planted, but they are of different sorts; no end of different sorts; perhaps a hundred. Then you want to select those which are considered the best, and any one that has the least tendency to disease you would reject at once. I have a few myself that I have raised from seed put in the garden last year. The whole lot went bad, except

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Chairman—continued.

except one, but I do not think it is a very good sort.

1342. You say that you do not consider that farmer's work?—No, a farmer has not the time to attend to it; it wants to be done by a practical gardener.

1343. Does it pay a practical gardener to undertake it?—Certainly not.

1344. It is rather a speculative business?—Yes.

1345. Do you consider the fact of a gentleman like Mr. Nicoll taking it up, is an accident which we cannot count upon having repeated?—Yes.

1346. You think Mr. Nicoll was one man by himself?—I think so.

1347. Are there many men like Mr. Nicoll, who cultivate varieties?—Not in my experience.

1348. You only know of Mr. Nicoll?—I only know of Mr. Nicoll, and he brought out this Champion potato; in fact, I know very little of him, except from going there once a year and seeing it grown.

1349. There are not many men in England or Scotland who undertake that class of business, of cultivating new varieties, as far as you know?—No.

1350. You think that Government ought to take it up and try and produce new varieties?—The question is an open one about the Government; but I think perhaps the Royal Agricultural Society, or the Highland Agricultural Society of Scotland, or any like society in Ireland, might do it; or it might be done by Government if you like; but I should think it would be almost more likely to get done by the large agricultural societies giving a prize.

1351. You think it would be very useful for the practical farmer to have this cultivation of different varieties of seed encouraged?—I think so.

Mr. *Stewart.*

1352. How would you propose that the large societies should take the matter up. Would you give a prize for the best field of potatoes grown in different counties. Unless you had it distributed over a considerable area of climate and different qualities of land, would not the experiment be somewhat useless?—No, I do not think it would be. There is no doubt it would be attended with some considerable amount of trouble, and it would be very necessary that you should appoint proper judges. For instance, supposing you started a dozen people to grow them, and they all raised their own varieties, they might be exchanged from one place to another. Different growers in the various counties of either England, Scotland, or Ireland, might exchange, and you would thus get all the varieties together. Supposing, for instance, that I raised some nine or ten different sorts, and you did the same, and another gentleman did the same all over the place. In the following spring, about planting time, we might each exchange; I might send you some of mine, and you might send me some of yours, and then we should get them all grown together, and then it would be a test who was going to get the best ones.

1353. It takes about five years for a potato to come to perfection, does it not?—I do not think it does.

1354. How long would you give it?—I should think you would get it very well in four years, and I think you would get a very good knowledge of it in the third year.

Mr. Stewart—continued.

1355. For the first two or three years you would not anticipate a large result?—No, certainly not.

1356. Still you think it ought to be attempted?—I think it ought to be done.

Mr. *Macdonald.*

1357. You said that you cultivated yourself from the plum or seed; did I understand you correctly?—Yes.

1358. What potato was that?—I got the seed from the Victoria.

1359. The first year you would have small potatoes?—The first year I had a small lot of potatoes about as big as peas or beans. The second year they came to a fair size, and then nearly all went bad except one sort. Now the third year I have got them in now growing.

1360. Is it a hybrid potato, or is it a potato bearing the character of the Victoria still?—It is neither the one nor the other.

1361. There is no distinctive character in it?—No.

1362. Now you have been asked by the honourable Member for Wigton respecting how you can best promote the growth of new seeds or new potatoes, and thereby give the country knowledge; do you not think if there were a series of Government farms, say on pure moor land or a portion of moss land, with other land in Ireland, Scotland, and in England and Wales, where as you very properly said a number of experinced men might be placed whose whole time would be devoted to the production of seeds, such as you have referred to in your own experience, that that would be much more likely to lead to a speedy knowledge of a good potato, or a potato that would be fortified to some degree against disease?—Well, I think possibly it might. I am quite aware that potatoes grown in mossy land are less liable to disease.

1363. That is your experience?—Yes, my experience as to bringing seed from a long distance away, is that it is a great advantage. It is a question of the sort of potato. My own opinion is that these Champion potatoes, being a very large coarse growing potato, ought to be grown in the south for a year or two and then tried in the north again.

1364. You think changing its position is what improves potatoes?—Yes, I think it would improve the potato.

1365. But would the matter be far better carried out by the Government experimental farms in the way I have referred to, than by private enterprise?—Well, possibly it might. I should think probably it would if the Government did that.

1366. Is your land that you cultivate, open land or woodland?—It is all open land.

1367. Have you any experience of growing the Champion on wooded land?—No, and nobody else would grow Champions on wooded land. I think that is a sort of awkward question to ask anybody to grow potatoes in a wood. I never saw it in my experience.

1368. I mean land surrounded by timber, not under timber?—Yes, surrounded by timber.

1369. Surrounded

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Mr. *Macdonald*—continued.

1369. Surrounded by plantations?—I have seen them grown so.

1370. Were they as healthy then?—It is not good for any sort, no matter what sort of plant. Where there are a lot of trees and the ground is sheltered, and there is a great amount of moisture, there is almost sure to be a great deal more disease.

1371. Have you experienced that which the former witness stated he experienced, that after a thunder-storm the disease appeared?—Yes, it has been attributed to that, and generally speaking we are very apt to get disease very frequently after a very heavy thunder-storm and rain and it turns out warm.

1372. Accompanied by rain?—Yes.

1373. Have you seen the disease appear without moisture?—Very seldom.

1374. You are inclined to believe that it comes from the moisture?—Yes, we never think about looking for any disease in dry weather. I recollect when the disease first came very well. We had extremely warm weather with heavy thunder-storms, and it seemed to come then, but the singular thing is that this disease came all over the world the same year.

Mr. *Arthur Moore.*

1375. You spoke about your Victorias and Regents being almost a failure last year; what did you do with the stalks of the rotten potatoes?—When they get diseased they very soon go altogether. If they get very much diseased the stalks rot right away.

1376. Still there is a sort of dry substance left even after that?—There might be this year; there was not last.

1377. What do you do with the potatoes that are not fit for eating?—Give them to bullocks and pigs.

1378. Do you think it is very necessary that whatever remains of rotten potatoes or stalks on the land should be gathered up to prevent disease?—No.

1379. You have no particular view to give as to that?—No; I think it is all nonsense. I think it is a well-known fact that the diseased potato has just as much starch in it as a sound one, and it would be folly to burn that. My experience is, that diseased potatoes are a great deal better for cattle then sound ones are. I have fatted hundreds and hundreds of bullocks upon diseased potatoes and cake, and other things. They are the only root I have used, and if you were to say to me will you take sound potatoes or diseased ones, I should take the diseased ones, because there is nothing like so much water in the other.

1380. Have you had any experience of the Magnum Bonum?—No, but I have seen it grown, and I have grown a few myself.

1381. What do you think of it?—I think it is no use at all.

Mr. *Round.*

1382. Do you use farmyard manure with your potatoes?—Yes.

1383. How much an acre do you use?—It depends on the season, and how the land has been farmed before; varying perhaps from 12 up to 20 loads an acre.

1384. Do you put on artificial manures besides?—Yes.

Mr. *Round*—continued.

1385. What artificial manures do you use?—I use principally mineral super-phosphates, sulphate of ammonia, and crude potash salts principally.

1386. You have been asked about wood-land: I suppose you would not put potatoes near wood land if you could help it?—No, certainly not; you might as well plant them in a coal mine.

Mr. *Storer.*

1387. Have you had any experience of using lime by way of preserving the tubers after they have been got up, dusting them with lime to check the disease?—No.

1388. You have not known of that being done?—I have heard it talked of; but all these things were tried many years ago, and they have never seemed to have any effect. In fact, I have watched the potato now ever since I was a boy, and I have been engaged in the cultivation of it for the last 40 years. It has been tried upon land that has never had any manure, and tried upon land that has been farmed as high as it possibly could be; but my experience has always been that the larger the crop we grow the better, simply because, although we should have a larger amount of disease, we should have a larger amount of goodness.

1389. You think that experiments might be usefully instituted by Government?—I think so; by Government or by some of the agricultural societies.

1390. And you think probably that if we had a minister of agriculture he might be usefully employed in superintending experiments of this kind, the same as is done in other countries?—I think possibly he might.

Sir *Edmund Filmer.*

1391. You have been farming potatoes a good many years, have you not?—Yes.

1392. And you say it was not until 1877 that you began to use these Champions?—Yes.

1393. What sort did you plant before?—I used to plant principally Regents.

1394. And you were pretty successful with them?—Yes.

1395. In fact you have been altogether a very successful potato grower?—Yes.

1396. In your part there has been a good deal of woodland grubbed, has there not?—Yes.

1397. Have you taken any of that land into your hands?—Yes.

1398. Have you used that for growing potatoes at once?—Yes.

1399 Have you found the disease come there?—I found they were more likely to get bad there; on the fresh grubbed ground.

1400. Your neighbours grow a good many potatoes; there are a good many grown in that district?—Yes.

1401. What varieties do your neighbours grow?—Pretty much the same sorts.

1402. Do they grow Champions?—They have not yet; they still stick to the old sorts. I tell you candidly my own opinion is that the Regents are totally done for. I consider it a folly and waste growing them, but people as a rule will stick to the old thing.

1403. Last year you were successful with your Champions; how were your neighbours with their sorts?—They had them nearly all bad. There

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was a neighbour of mine who had a 50-acre field adjoining mine of Victorias, and I should think they were not worth 2 *l.* an acre.

Sir *Hervey Bruce.*

1404. Do you consider shelter bad for early potatoes?—Yes, I think that shelter for potatoes is bad; that is near trees, because we find when ever the disease first appears it always appears in the gardens, and in sheltered places. Frequently you will find the disease in the gardens, when we have never had anything in the fields at all.

Sir *Edmund Filmer.*

1405. Your country is a very open country?—Yes, mine is.

Mr. *Evans.*

1406. Have you made much use of foreign potato seed?—No, I have tried several different sorts; in fact there is hardly any variety but what I have tried. The foreign sorts are of very little use, in fact I never got a good foreign potato yet.

Mr. *Earp.*

1407. Have you yourself in some years escaped the disease entirely?—Yes.

1408. And some years you have had it partially?—Yes.

1409. Have you noticed at all when it has been partial in its character, whether the sets which have been growing in the lower parts of the field have been attacked more than those in the higher places?—Well, I could not say much about that.

1410. You have not observed that?—No; mine is pretty even land.

1411. Did you raise the plum or the pod yourself, from which you obtained the seed you experimented with?—Yes.

1412. It was grown on your own land?—Yes.

1413. At what time did you take that pod, considering it ripe?—I took it in the autumn, and laid it in some sand in a flower-pot, and let it stop there till the spring.

1414. That was to dry it, and prepare it?—Yes.

Mr. Samuel Coleman, called in; and Examined.

Mr. *Coleman.*

Sir *Hervey Bruce.*

1415. You are a grower of potatoes as well as a dealer in potatoes, in the county of Londonderry, in the north of Ireland?—Yes.

1416. You do not experiment with seed?—No.

1417. You grow potatoes in different localities?—Yes.

1418. Do you ever take fields spread over the country not in your own occupation entirely, for the planting of potatoes?—No; I buy them growing.

1419. What kind have you grown yourself?—I have grown Skerries, and Rocks, and Champions; in fact, a good many kinds.

1420. Which kind do you consider yourself the best?—The best for the last four or five years past is the Champion, from my experience.

1421. Have you had much disease with the Champions?—No, very little.

1422. Have you had much more disease with the other kinds that you have grown?—Yes, a great deal more, and not half of the quantity to the acre of produce.

1423. Do you find that there is more or less disease in the potatoes which you cultivate yourself, and those which you buy from other people?—I think there is less in the ones I grow myself.

1424. To what do you attribute that?—I exchange my seed very often; I bring new seed.

1425. What kind of manure do you generally use?—Generally farmyard manure bought in the town.

1426. Do you consider the artificial manure good and useful for potatoes?—Well, it is, if you cannot procure farmyard manure; but I believe that farmyard manure is the best for any crop.

1427. Do you think you can put too much farmyard manure on?—No, I think not; we cannot afford to put on too much.

1428. But do you consider that stimulating manures are bad for the potatoes?—Yes; we have more diseased potatoes when we manure heavily, but we have a larger crop of good and bad.

1429. Do you use lime?—Yes.

1430. Do you use that when you are planting the potatoes?—No, I generally put it upon the grass land, that is two years before I plant the potatoes.

1431. You do not use it the same year as you plant the potatoes?—Yes, I have done in some cases.

1432. Do you export potatoes to a large extent?—Yes.

1433. Do you ever import potatoes?—Yes.

1434. What is your experience as the imported potatoes, as to the best kind for standing?—Champions, at the present time, is the best kind.

1435. Have you found potatoes which looked healthy when you pitted them, become diseased in the pits?—Yes, I have seen them become diseased, but I believe they were touched before they went into the pits, though it was not visible.

1436. As a rule, when does the disease first appear?—I think at the end of July, or the beginning of August, where I come from—the north of Ireland.

1437. Do you think that the age of the potato or the time of year has much to do with the appearance of the disease?—I think age has something to do with it.

1438. Which kind of potato resists disease best, that grown from large potatoes cut, or that from small ones whole; have you tried that?—Yes, some years ago; but I believe those grown from the large potato, cut, are the best.

1439. Which system do you consider best, the lazy bed or the drill, for very wet land?—For very wet land the lazy bed, but for any kind of dry land the drill is the best.

1440. Have you ever seen what was described by a former witness; lazy beds planted of such a width, that when the first year's crop was taken out they ploughed them up and split them, Sir *Hervey Bruce*—continued.

them, and then grew potatoes the second year in what was shovelled over?—Yes, I have seen a small farmer do that, but it is not a usual thing.

1441. Have you ever tried planting potatoes in the autumn?—No.

1442. What time of year do you consider the best for planting them?—About the end of March or beginning of April, if the weather is favourable.

1443. Where do you get your new seeds from?—I have tried them from Scotland, England, France, and Germany.

1444. Which of those four places do you consider you get the best seed from?—The best I have got for several years is the Champion.

1445. I need scarcely ask you whether you consider land ought to be well drained for growing potatoes?—Yes, it is necessary that the land should be well drained, and dry land is the best.

1446. Have you ever planted potatoes in what we know in the north of Ireland as uncut black bog?—I never did myself.

1447. Have you ever bought any potatoes grown in that?—Yes, I have bought potatoes in what we call bog land, reclaimed from the bog.

1448. I am not asking you about reclaimed land; I mean pure black bog?—No, I have never bought them.

1449. But you have bought them from the reclaimed bog land?—Yes.

1450. Is it your experience that a potato grower in that way, in almost virgin soil, is freer from disease than if grown in fields which have been cultivated for many years?—Yes, I have seen it rather clearer of the disease.

1451. Have you ever imported potatoes as Champions and found that they were not Champions when they arrived?—No.

1452. Have you ever seen any potatoes being sold as Champions which came from either England or Scotland, and which were not Champions?—I cannot say I have seen them myself, but I have heard of them.

1453. Which do you think would be the best plan to secure better potatoes with freedom from disease; you have heard the former witness asked as to prizes and that kind of thing; have you ever given attention to that part of the subject?—Yes, I have thought of it.

1454. Which do you think would be the best plan?—I believe prizes would be an advantage, but they would not be an advantage to the north of Ireland, for in many cases the small farmer, or what you might call small farmers, could not all take advantage of it. One farmer might have a dry soil and the next farmer might have a heavy clay soil, and the man with the heavy clay soil could not grow as good a crop of potatoes as the man with the dry soil. For that reason he would not be able to take advantage of those prizes; he would not think of it; he would not think of exhibiting his crop at any time.

1455. That only applies to the individual getting a prize; but do not you think that distributed over the country it would be good for the general use if people got prizes for cultivating the potato successfully?—No, I do not think it would be a general thing. I think every one would not take advantage of it; but I do believe it would do good.

Sir *Hervey Bruce*—continued.

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1456. Have you seen any of the crops which, I understand, in our part of the country have been injured by the frost this year?—Yes.

1457. Do you look upon that as a permanent injury to them, or do you think they will recover?—Some of them will recover, and some of them, I believe, will not.

1458. Have you ever seen the crop in former years destroyed as it has been this year?—Not in that season of the year. I have seen it earlier in the spring of the year.

1459. Do you think that a field with trees near it is very bad for the growing of potatoes?—Generally when the disease sets in you will see it rather sooner than you will see it in an open field.

1460. Do you think shelter of any effect in making the potatoes earlier than if they are in a more exposed situation?—No, I think not in fields. If you have shelter they will be a little earlier, but where they are sheltered with trees there will not be so good a crop.

1461. Is it your experience that the early potatoes flower or not?—I do not plant many early potatoes; I grow them all out in the farm.

1462. Have you ever tried any of the disinfectants on the potatoes, which are advertised for stopping the disease?—No.

1463. Is it your experience that the Regents never have seed?—I never saw them having seed.

1464. Do you consider it necessary to burn the haulm of the diseased potato?—No, I think not.

1465. Would you prefer diseased potatoes, for feeding, to sound ones?—No, I should rather have the sound ones as the result of my experience.

Chairman.

1466. What kind of potatoes did you grow before you got into Champions?—Skerry Blues, White, Brown, and Red Rocks.

1467. Any Green Tops?—No, I never grew any Green Tops. I have grown American Whites.

1468. Have all those classes of potatoes got largely diseased in the last years?—They have.

1469. Have all the different varieties of Rocks?—The Rocks have; the Skerry Blues have not as much disease, but they have grown no quantity to the acre this last few years.

1470. And they are all very inferior to the Champion potatoes?—They are; all the kinds I have planted.

1471. How do the small farmers in Londonderry get their seed?—They generally keep the refuse of what they have for seed, for they either sell or use all the potatoes that are fit for use, and if any of them do keep any, it is the refuse of their crop, and that is planted year after year.

1472. Do they ever grow their seed in bogs, and then grow them next year in the uplands?—Yes, they do.

1473. Is that a good plan?—Well, we consider it is, a change of seed.

1474. And that is the only change they give?—That is the only change the small farmers give; they generally use their own seed potatoes; the refuse.

1475. Are not the potatoes grown in the bogs in that way very small?—They are generally small.

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Chairman—continued.

1476. They are fit for food the next year?—I do not think they are any better.

1477. How can the small farmers be got to change their seed?—The only way in which I think they could be got to change their seed would be to sell them good potatoes at the price they could buy these small refuse potatoes at.

1478. But somebody would have to lose upon that; you could not get good sound potatoes at the same price as the refuse?—No. That is my experience. I have had the Champions now four years, and I know several of the farmers in the neighbourhood have not availed themselves of any of them yet, and they have seen them grown, and they know them to be a good potato. Some of them are not able to buy them. There are generally a good many small farmers with us, and a good many of them are well enough inclined; they are industrious.

1479. But it is very hard to get them to spend money on the seed?—In fact, they have not the money or the knowledge. They want both.

1480. Do you know any way in which they could be got habitually to change seed from year to year?—The only way I know is, if they could get good seed potatoes, such as the Champions, at the price of the seed potatoes they generally plant.

1481. There are generally seed merchants about; do the seed merchants sell potatoes for seed much in the country towns in Ireland?—No, they do not.

1482. They sell the other sorts of seeds, turnip seeds, and other classes of seeds?—Yes.

1483. Those are to be got in any country town in Ireland?—Yes, all country towns in my district.

1484. But in the small country towns are good seed potatoes to be got from the seed merchants as a rule?—No; they generally keep some early potatoes.

1485. Special potatoes; but ordinary sorts of potatoes are not to be bought?—No.

1486. So that if a small farmer wanted to buy good sound seed potatoes, he would find some difficulty in buying them?—No.

1487. How would he get them?—He would get them from a man who deals in potatoes.

1488. Potatoes for seeds or for market?—A man who deals for the market; buying, shipping, and selling for profit.

1489. Does that man look to see if he has got good seed, like a seed merchant is supposed to do?—Yes; a respectable dealer will look particularly to see whether he has got good sound potatoes of the kind.

1490. Are you talking of large towns or of small towns?—Of small towns, such as Coleraine.

1491. And good seed is to be got there?—Yes, as good seed of this kind as any other place that I know.

1492. Do you find the sound potatoes get more diseased when you store them up?—No.

1493. If you put in your potatoes most of them sound with a few diseased ones, do the sound ones catch the disease in store?—I do not believe they do.

1494. Do those put in diseased get worse in store?—They do.

1495. How do you store your potatoes generally?—In outhouses and pits for a length of time, and before they begin to grown we remove them to a potato house.

1496. Tell us exactly what you do about getting your potatoes together; you have told us you have bought them growing?—I grow a good many myself, from 25 to 30 acres on my own land from year to year. I then buy potatoes growing from the neighbouring farmers and raise them myself at my own expense and ship them.

1497. What do you do with them before you ship them; put them in pits or send them straight off?—Sometimes I put them in pits, and at other times I bag them up and put them on vessels and send them away.

1498. Do you generally send them out of the country?—I ship them to England and Scotland.

1499. Is there a large amount of Irish potatoes goes to England and Scotland?—A large amount from our port.

1500. Do you think the system of cultivation produces much difference in increasing or diminishing the disease in potatoes?—Yes; I think good cultivation is a help to the prevention of the disease.

1501. A considerable help?—I think it is a little help.

1502. Do you consider it is more a help than choice of seed?—No; I think the seed would be the most.

1503. You think that is the really important point?—Yes, I do.

1504. Can you give us any idea of any legislation or any action on the part of the Government which would be useful in diminishing the disease?—Yes; I speak of the part of Ireland that I come from. I believe drainage of the wet land would be a help in that respect. A change of seed would be another great advantage, and I should say that that could be done in this way; the seed brought into the country by the Government or purchased pure of its kind and offered to these small farmers at a low price, that is, the same price as they could buy their refuse seed they now plant year after year; that would be a great improvement.

1505. Is the Government to lose money on the seed potatoes?—If the Government wishes to improve the cultivation of the potato they will require to do something.

1506. Is the Government to sell them at cost price or below cost price?—I think they should be sold below cost price.

Mr. *Stewart.*

1507. Did you ever try cutting away the haulms to stop the disease?—I did when the disease came into the country.

1508. Had that the effect of stopping the disease?—I do not believe it had.

1509. Did you continue it or discontinue it?—I have not done it for a good many years.

1510. You found it was no use doing so?—Yes.

1511. Do you always make a habit of burning the haulms?—No, I never burn them.

1512. You have never tried that?—I have never tried that.

1513. Do you think it is chiefly a matter of the seasons whether you have much disease or the contrary?—No, I do not think so; I attribute it to a good many causes. The potato has been a good while in the country; it has been badly cared

Mr. *Stewart*—continued.

cared for, the very worst of the potatoes planted, and consequently the potato has degenerated year by year and got worn down in its constitution.

1514. How many years do you give a particular variety of potato to be a prolific fruit bearer?—It depends a good deal on the variety, I believe; some sorts will stand longer than others.

1515. Do you think that the Champion is going to be a long-lived potato?—Not in my opinion.

1516. Then you corroborate the last witness in his opinion; what is your reason why it will not last?—I go by the potato itself, and by the experience I have had in growing and using it, and I do not think it will be a long-standing potato.

1517. You do not think it is a hardy potato?—I do not.

1518. One thing which affects liability to disease is the change of seed?—Yes, I believe that is a great help.

1519. What is the next reason you have?—Good cultivation, good drainage, and several other things.

1520. You have never tried smearing potatoes with petroleum?—No.

1521. And you have never tried any disinfectants?—I have tried lime as a disinfectant.

1522. What experience have you had with that?—Well, it has been more for manure.

1523. I think you stated that you applied lime two years before the potato crop to the grass?—I generally put in on two years before the potato crop.

1524. What is the reason of that?—The reason I put it on two years before the potato crop is that I can put it on with less expense.

1525. Do you consider that land is better manured by the cattle being better pastured?—Yes, the land is better worth the lime.

1526. It is much more open?—It is a great deal better in every way.

1527. You think that is more preferable to putting on the lime with the potatoes?—I do not know that it is any more profitable, but you can put it on with less expense.

Lord *Moreton*.

1528. Have you noticed that the disease usually appears first in gardens?—Yes, generally you will see it in gardens before you see it in the open field.

Mr. *Macdonald*.

1529. Have you at any time made a study of the period of the attack of the disease on the potato?—Generally in the north of Ireland it is at the end of July or the beginning of August that the disease sets it.

1530. Have you observed any proximate cause, such as thunder?—No.

1531. May I ask you in what part of Londonderry your farm is?—It is in the suburbs of Coleraine.

1532. Then you do not agree with the theory that that thunder produces it?—Well, if it comes on raining about the time of thunder and lightning, we generally see it immediately after.

1533. It is not the thunder that produces it?—No.

1534. It is rather the moisture consequent upon the thunder?—I think when we have a

Mr. *Macdonald*—continued.

great quantity of moisture, we see the disease sooner.

1535. Do you grow Regent potatoes at all?—I have grown them.

1536. Have you grown potatoes known by the name of Dalmahoy?—No.

1537. You have not seen that potato?—I do not remember seeing it.

1538. Have you studied the habit or the character of the Regent potato at all?—No, I have only the experience of growing it and shipping it.

1539. Is it attacked more by disease now than it was 20 years ago?—No, I do not believe it is so much.

1540. Do you think it retains its character for freedom from disease now as much as it did 10 or 12 years ago?—Yes, it is a great deal less subject to disease. In 1846 or 1847 they were nearly all gone with disease.

1541. Have you ever seen any seed of the Regent potato?—I do not remember to have seen any.

1542. Are you aware of the cause of that?—I am not.

1543. Are you aware that the Regent potato is a male potato?—Yes.

1544. Consequently it never seeds?—No.

1545. It never has any plum, or anything of that kind?—No, I have never seen any.

1546. Have you studied it to a sufficient extent to say that consequent on its being a male potato its strength is thereby greater?—No, I have not studied that.

1547. But in all your experience you have never seen seed pods or plums upon the Regent potato?—No, never to my knowledge.

1548. Have you ever heard of anyone who has seen them?—No.

1549. Of course you do not know the Dalmahoy potato?—I have seen it.

1550. Are you aware that it does not seed either?—No, I am not. I have never grown it.

Mr. *Arthur Moore*.

1551. Have you seen anything of the Magnum Bonum?—Yes.

1552. What do you think of it?—I have only seen it; I have never grown it.

1553. Have you ever eaten it?—No.

1554. What do you say is the most important step you can take with a view of preventing the disease?—I think the most important step, and the very best, would be to grow a fresh variety of the potato, say from the wild potato, as it originally came; then introduce it into the country, and bring it within the reach of all classes of farmers.

1555. So that what you mean practically to say is this, that change of seed is the one thing?—Yes, it is the one thing.

1556. It is the most important thing?—I think it is one of the principal things; a change of seed; bringing a new kind of potato into the country and distributing it over the country.

Mr. *Colman*.

1557. Have you had any experience as to what is the best time for putting manure on to the land for potatoes?—I believe the autumn is the best time.

1558. Not the spring?—Not the spring.

1559. Do

Mr. *Coleman.*

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Mr. *Macdonald.*

1559. Do not you think it would be much better if we had Government farms experimenting constantly for the purpose of bringing out new classes of potatoes?—I think it would be of great advantage, but I think it would be a long time before they could be brought within the reach of small farmers in the north of Ireland.

1560. Would it be longer than it is now?—Yes, it would, because if the Government wished they could bring these Champion potatoes, for instance, into the hands of small farmers at the present time.

1561. But I think you have expressed the opinion that the Champion is not a long liver?—That is only my opinion.

1562. Would it not be desirable that there should be Government farms or institutions of that description at which seed like the Champion might be grown, and other suitable seed?—As far as I know it would do no harm, but it would be a long time, as I have already remarked, before it would come within the reach of small farmers such as we have in the north of Ireland.

Chairman.

1563. With regard to getting seed to the small farmers, there would be no difficulty in making them take the seed; if the seed was given them on credit by the poor-law union in the spring, and they were not to pay for it till September?—A good many would take it on those terms.

1564. There would be some difficulty in getting the money afterwards?—I think it would only make them worse off instead of better; for instance, when they had grown the potatoes, and they have come to maturity, they and their families would use them, and I do not see they would be in any better position in a year or two after than they would be at the time they got them.

Sir *Hervey Bruce.*

1565. You are aware that in our part of the world, one of the districts had seed potatoes issued to them by the board of guardians?—Yes, I am aware of that.

1566. Were you present at the buying of any of these potatoes that were issued?—I myself supplied 20 tons to the Antrim Union; I contracted for them and sold them.

1567. Did you supply any to the Coleraine Union?—No, none for seed.

1568. Did you see any that were supplied for seed?—I did not, but I know the man who supplied them. He got the seed from me a year or two before the Champion seed.

1569. Of course I need not ask you whether the seeds that you supplied to the Antrim Union were a good quality of seeds?—They were pure of their kind; there was not one to my knowledge of any other kind supplied by me.

1570. Do you desire any question to be asked of you upon this letter which you have handed me, signed by "A Traveller"?—Yes.

1571. Perhaps the simplest way would be for me to read the letter which I see appeared in the "Coleraine Constitution," a local newspaper, on the 14th September 1678: "Dear Sir,—Business having called me to Ireland for the past few months, and being much interested in agricultural business, caused me to notice the several crops in different districts in Ireland. In travelling through the County Dublin, I saw some potatoes

Sir *Hervey Bruce*—continued.

called Champions, the finest crop I ever witnessed, or that could be grown in any part of the world, I thought; I left that about three days ago, and at that time they were quite green and free from any blight or disease, as if in the month of June. Having arrived in Coleraine I was expressing myself about the superior quality of the potato crop in the County Dublin, as I was expressing the same view at all my stoppages. I was asked to view a field in the neighbourhood of Coleraine, the property of a gentleman named Mr. Samuel Coleman, of the same kind, and I really certify that they surpass anything I have yet seen anywhere. The field I saw I think contains 15 acres, all of which are free from blight or disease, or the appearance of any, covering the surface with tops not less than three feet deep, hiding the appearance of drills or ridges. Farmers throughout England have been anxiously seeking for these Champions, and were these in England they would sell for 70 *l.* per acre for seed purposes, as the English farmers regret they could not get a sufficient supply last season, as Scotch farmers have a larger supply than the English, and they complain they have not all their crop of the same sort. I am informed Mr. Coleman has another lot, besides the field I saw, making in all 20 acres, equally as good. I have not had the pleasure of seeing Mr. Coleman himself, as his style of farming seems good, but I would venture, without fear, to challenge any man in Ireland to show 20 acres equal to these, same quantity and quality. I am certain if this sort of potatoes be planted in this and other countries as the principal potato, the disease will soon not be seen. And sir, I am happy to find such a crop in this country, and will on my return to England be able to explain the growth of the Champion potato in Ireland, though I find that not all the farmers have them here more than with us in England; and I think one and all should grow them, as I believe they will be the only standing potato for years to come." Do you know the writer of that letter?—No.

1572. His opinion is different to yours as to the nature of the Champion?—Yes.

1573. But he thinks they will be a standing potato?—Yes. Of course it is only my opinion, and I may be wrong.

1574. That shows, I think, that you have cultivated Champions successfully?—Yes.

Mr. *Arthur Moore.*

1575. What is the price usually given for seed potatoes, in your experience, in ordinary years?—The average price is generally from 4 *s.* to 5 *s.* a hundred weight, that is eight stones.

1576. That is 6 *d.* a stone?—Yes, that is the middle-sized potato, but the smaller class sell for less.

1577. What did the guardians charge this year to the poor for the potatoes that you sold to them?—I know I got 10 *l.* a ton, delivered.

1578. That is over 1 *s.* a stone?—Yes; it would be 14½ *d.*

Mr. *Stewart.*

1579. I understood you to say you cultivated the potatoes, generally speaking, in ridges?—No, I do not cultivate them in ridges; I cultivate them all in drills.

1580. Did you ever adopt this plan: after the potato is planted and drilled up, to smooth it down

Mr. *Stewart*—continued.

down in order to let the hot sun get to the plant quicker than it otherwise would do, by lightening the top burden of the earth over the potato?—Yes, I do not smooth it down, but I harrow it so that the sun and the air can get as near to the potato as possible.

1581. You always do that?—Yes, I always do that.

Mr. *Earp*.

1582. Do you cut the sets?—Yes.

1583. Do you do that habitually?—Yes; I do that habitually, besides experimenting in planting whole potatoes.

1584. Do you think that advantageous, irrespective of the increase it gives you?—No; I think the sets is just as good a way as anything I have tried, taking everything into consideration.

Mr.
Colman.

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Mr. *Round*.

1585. You choose the biggest potatoes?—No, I should choose a middle-sized potato, well shaped.

1586. You would not choose the smaller ones?—No, I have done it, but never think it a good plan.

1587. What do you do with your small ones?—I feed cattle with them.

Mr. WILLIAM INGRAM, called in; and Examined.

Mr. *Earp*.

1588. YOU have charge of the whole of the gardening operations, and direct them, at Beauvoir Castle?—Yes.

1589. You have had long and large experience in connection with gardening operations of all kinds?—Yes, all my life.

1590. You have, I think, given special attention to the growth of the potato?—Yes, I have made many experiments in the cultivation of potatoes necessarily.

1591. Were you led to make those experiments in consequence of the prevalence of disease from time to time, and from the desire to discover remedies?—Yes, chiefly.

1592. Perhaps you will describe to the Committee the method you have adopted; will you make a short statement of your experience?—I have a clay soil principally to deal with, we are on the lower lias limestone soil, and the upper surface is cultivated to about 18 inches, or in some cases 2 feet. It has been very necessary that I should make the soil as light as possible, and so my principal manure has been burnt earth, or what we call burnt earth, that is charred vegetable matter, which I have used very largely. Instead of planting potatoes below the surface 6 inches, as they generally do, I have found it better to place them on the surface, and to dust them with the charred refuse which I speak of. Then I earth them up with a particular kind of hoe which we use, and which is locally called the hassock hoe; it is usually employed for cutting large pieces of grass; and by placing the potato on the surface and throwing the soil over the potato it has the advantage of all the good soil, both below and on each side, drawn to it. In that way I have got very large crops of potatoes, and in cases of heavy rains, by the earthing up early like that the rain is thrown off and the potato always enjoys all the advantages that the soil can give. That has been a system I have been gradually led to adopt, and in that way I have certainly had immunity from disease, particularly in early sorts.

1593. You have experienced immunity?—I have experienced immunity. For instance, I have grown a kind of ash-leaf kidney potato for many years, without suffering from disease.

1594. That is an early potato?—That is a very early potato, and by carefully selecting the sorts which show in their constitution a power of resisting the disease, I have been able to secure very fair crops even in very bad seasons.

Mr. *Earp*—continued.

Mr. *Ingram*.

1595. The ash-leaf kidney potato generally comes to maturity early enough to escape those climatic conditions which are supposed to be so very unfavourable, does it not?—Yes, but still it is liable to disease. All potatoes at a certain period of growth just before maturity are liable to disease, even the ash-leaves.

1596. Can you give us an account of your experience with regard to later maturing potatoes?—Yes. I grow principally one called the Early Don to succeed. I also grow "Myatt's Prolific" and "Mona's Pride," and following that a Regent potato, or something of the character of the Regent, called the Early Don. That is only an early variety of the Regent, and following that I grow the Regent, it being a high-class potato, and it being an object with me to secure potatoes of the highest possible quality for the table. In that way I devote a good deal of cultural attention to them, and I have selected year by year potatoes which have resisted the disease the best. You often find in a large square of potatoes certain potatoes which seem to have the power of resisting disease, and these I take up, and in that way I secure a potato of a stronger constitution.

1597. Have you escaped the attacks of disease more than your neighbours during very bad disease years?—I believe so.

1598. You have never lost entirely the whole crop?—No, certainly not.

1599. But you have had disease?—Yes, I have had disease, because the situation I grow them in is rather unfavourable. It is in clay, as I have described. Of course I have not the same chance of success as those have who grow potatoes, for instance, on marlstone, on the middle lias.

1600. The fact of your having to grow your crop in clay, has suggested to you the method you have described of procuring more friable tilth and better drainage?—Yes. I also depend more upon fresh soil than I depend on manures. I am not fond of using manures for potatoes; for instance, stable manures, cow manure, or pig manure, but I use manure containing potash, such as charcoal and burnt ashes, not coal ashes; and also my system is always to bring up the bottom soil. Every year I bring up a certain quantity of soil from below, and that is exposed during the winter to the action of the atmosphere, and then it becomes a manure.

Mr. *Ingram.*

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Mr. *Earp*—continued.

1601. Then, in pursuing the growth of a potato, you attach considerable importance to choice of ground and choice of seed, and to the storing of seed?—And to the storing of seed.

1602. With regard to choice of ground generally, we may gather from what you have already said that you think that is very important?—That is most important. I should not choose strong ground to grow potatoes in, but I have no choice, and therefore I have made the best of the circumstances I have about me.

1603. Then with regard to choice of seed, do they attach great importance to that?—Yes, considerable importance.

1604. What practice would you recommend in order to secure the best choice?—I give a preference I must confess to the seed I have saved myself by selection; but occasionly I get change of seed from a distance. I find an advantage in that. There is less liability to disease in potatoes grown in another district in soil quite contrary to that which I have. We have in our district a considerable area of light soil resting on the middle lias; that is on ironstone; and potatoes grown on that will make a very good change in clay.

1605. Then you think it very important that there should be a continual renewal of the seed stock?—Yes, a systematic renewal.

1606. Have you experienced in your own operations the exhaustion of certain sorts of potatoes?—Yes, very particularly. I have known the Dalmahoy potato, which has been spoken of to-day, run out completely. I cannot grow that potato. I have grown it successfully for a few years, and then I suppose the circumstances about it were not favourable to its particular constitution, and it totally failed. Another called the "Pink-eyed Regent," a very good potato, I have grown good crops of some years, but that has run out. I have also grown "Pattison's Regent" (that seems to possess a stronger constitution) more successfully, and I have still a number of that kind.

1607. Do you attach much importance to the storing of seed?—Yes, great importance.

1608. What method do you adopt?—The seed I collect is generally of middle size; neither small nor large, but perfectly matured. I expose them generally to green them rather than not, and then they are stored away thinly on the shelves in a house we have for the purpose; not piled together exactly; sometimes two or three one above the other, but not in clamps or in heaps.

1609. You give special treatment to potatoes intended for seed?—Yes.

1610. Does it occur to you that any method might be encouraged by Government which would tend to promote the object of this inquiry?—It occurs to me very forcibly that seed-potato farms would be most advisable under Government superintendence.

1611. By "farms," what should you lead the Committee to suppose you meant?—According to the demand of a district, but I should think something like a farm of 10 acres, and the cultivation of all the varieties of potatoes likely to be of use should be an object; the distribution of good seed should be an object, and the raising of better varieties of potatoes, a thing that can hardly be done by private growers, because you must grow a great many seedling potatoes before you would get anything that would pay you. Many people have attempted it; I myself have tried, but have not been successful. You may by some happy chance get a good variety, but you must grow a great variety before you get one that will compensate you for the trouble. Therefore, that is an affair more for Government.

1612. Do you think it probable that the success which might attend such a plan would cause such inquiry for the produce that such farms might possibly, under the direction of the Government, even be made self-supporting?—Yes, I see no reason. A reasonable price only need be charged, and then I think the reputation of these farms would be soon established, and there would be an anxiety to obtain seed and people would resort to them. I think that in the case of Ireland, and in many of our country districts where they grow potatoes, and where the potato is a root of very great importance, good seed is of so much importance that it is quite worth while that some attention should be given to it by Government. A remark was made to me by a labourer the other day to this effect: "My potatoes are coming up very well; all those I clamped and which I saved myself are coming up irregularly, but those you gave me are all as even and as strong as possible." That is simply a practical fact. You find that when potatoes are put together in heaps they grow one in the other, and the best eyes always start first; then they get broken off, and you get the weak eyes put in. So that if you have a perfect seed your chance is almost double of getting a good healthy plant. I regard the getting of a perfectly healthy potato as a matter of very great importance.

1613. Has it ever occurred that when you have assisted a very small grower in the same way, he has been able to point to a greater immunity from disease in the case of those potatoes which you have given him?—Yes, I have repeatedly had that the case. They are adopting my system in the small gardens, and I have had repeated instances of the importance of it; that is the system of planting in the surface, and earthing up and dressing with burnt earth.

1614. So that your own experience has been confirmed by others; that where this care has been exercised with regard to the growing and selection of seeds and storing, there has been greater freedom from disease?—Yes, unquestionably.

Chairman.

1615. Do you have much to do with early potatoes?—Yes.

1616. Do you think it would be possible to introduce the growth of early varieties to a larger extent amongst labourers and amongst cottagers?—Yes, I think it most desirable where a market exists, because early potatoes are largely at present introduced from abroad, and if our markets could be supplied with home-grown potatoes, it would keep the money at home which we now send abroad. All along the warm parts of England and Ireland, certainly, more early potatoes might be grown with advantage than are grown at present.

1617. Do you think it would be possible to grow

Chairman—continued.

grow early potatoes largely, so that the crop might come in before the disease showed itself?—Yes, that is very much my experience, and particularly where a demand exists for them, and they are taken up promptly.

1618. That there is no disease?—Yes.

1619. Either before they are taken up, or after they are taken up?—No.

1620. Till what date might potatoes come in to be ready for lifting before disease sets in?—In July; that depends on the district so much, because you can dig them in some parts of England in June, and in our midland district generally we dig them about the first week in July.

1621. Have you ever heard of potatoes grown in Jersey?—Yes, I have been to Jersey.

1622. Is it true that they have very little potato disease over in Jersey?—No; the potatoes are grown in a soil composed very much of decomposed granite, and it is something singular the vitality which is given to all things, both corn and potatoes and all kinds of plants, through the use of that particular kind of soil. I have adopted it generally in gardening now. I grow a great variety of plants, amongst others many Alpine plants, and I obtain from the Mount Sorrel granite quarries large quantities of the fine dust which is accumulated there in breaking up the stone, and I use that as one of my favourite manures for a large number of things, and I attribute great importance to that particular manure.

1623. That is decomposed felspar?—Yes, decomposed felspar.

1624. In Jersey are they very successful in growing potatoes?—Yes, and they export large quantities; the crop is not very large.

1625. Is there particular immunity from disease in Jersey?—By taking them up early I believe there is immunity for the very early kinds.

1626. You do not notice any wonderful difference?—No.

Mr. *Evans.*

1627. Is your subsoil magnesian limestone or carboniferous limestone?—It is neither; it is lower lias; there is simply about 900 feet of lower lias below us.

1628. You have mentioned that your own soil is clay?—It is a lias clay.

1629. Is it well drained and dry?—It is drained.

1630. I understand you to say you would not consider it naturally good potato land; you merely use it because you have got no other?—No, I merely use it because I have got no other. A clay district suffers very much from cold, and the subsoil influences climate; all our district is affected by a large area of clay.

1631. Of course it would not compare in any way whatever with the soil in Jersey?—No.

Mr. *Stewart.*

1632. Your plan of storing would hardly be applicable to a large farm, would it?—For seed storing it would pay anyone to have proper sheds for storing, which he might use for other purposes during the year.

1633. You do not think that the increased expense would deter landlords or tenants from putting up those storing sheds?—It might do so, certainly, but I still think it would pay.

Mr. *Stewart*—continued.

Mr. *Ingram.*

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1634. You have a very strong opinion on that point?—I have a very strong opinion upon that point.

1635. The great difficulty, I take it, with regard to growing quantities of earlier potatoes is the climate, the frost?—Yes.

1636. There is no remedy for preserving the crop against a late frost in spring, is there?—No. In Lancashire they take great trouble in covering them up, but I do not know anything except that. I have not suffered from frost this year. Although I have potatoes planted early, and some ready now to dig, they have not been affected by the frost.

1637. As a rule the early potatoes do not become so affected by disease as the later ones?—As a rule they do not.

1638. With regard to the point of Government assistance being given to growers in order to produce new varieties, and stronger seed, and a better constitution in the seed, do you think that that could be equally or perhaps better carried out through the agency of the large agricultural societies in the three countries?—I hardly think so, because there are no proper officers at present in connection with those societies. Societies are generally managed by a secretary, and the secretaries seldom possess that amount of information that it would be necessary to possess.

1639. You are aware that experiments in agriculture are being carried out now at Woburn by the Duke of Bedford?—Yes.

1640. Those are under the superintendence of the Royal Agricultural Society, or really under the superintendence of Dr. Voelcker?—Yes, that is one exception.

1641. Could not that equally be done in the case of potatoes in different parts of England?—Take Lincolnshire for example. There is a Lincolnshire Agricultural Society. I am not aware of any officers connected with that society competent to take the management of a potato farm.

1642. The experiment would not be very costly provided it was done here and there in 5 or 10 acre plots?—No.

1643. A certain compensation would have to be given to the occupiers of the land?—Yes.

1644. But it would not be beyond the range of any of these public societies if they were to undertake it?—No. There is a society which exists at Grantham, and a very great deal of good has been done by the distribution amongst the cottagers and others of seeds and fruit trees, and, in fact, anything that is required in the district. While I belonged to that society I ventured to suggest it, and it is now being carried out with very great success.

1645. Are you aware of any similar plan in practice in France under the French Government?—No, I have not so intimate an acquaintance with France of the present day. I spent some time in France in 1847. I have not had much experience since in France.

1646. Are you aware that the Government there have given great encouragement to local agricultural societies in carrying out different arrangements?—Yes; I am aware of one good arrangement by the Horticultural Society of Paris. When they hear of any successful results

Mr. *Ingram*.

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Mr. *Stewart*—continued.

sults of cultivation they appoint committees to go out and examine into the success or non-success of the thing that has been effected.

1647. Looking to the prejudice that it might be inferred would arise against the Government undertaking anything of that character in this country, would you be disposed to say that it would be better to trust to the present agricultural societies to carry on these proposed experiments, or to insist on the Government undertaking it?—I am disposed to think that it would be better that the Government should undertake it.

Mr. *Macdonald*.

1648. Can you tell us where the chief quantities of the early potatoes come from at the present time to England?—I know many come from Belgium, but I do not know the particular districts, and Jersey; and Cornwall grows a considerable quantity.

1649. Are you aware that a great quantity comes from Holland as well?—Yes; from Holland.

1650. Would it not be highly desirable, in connection with what you have stated, that you would prefer Government farms. I think that is clearly your view; that they should turn their attention to seeing the land from which our early potatoes come, and to learn if we have not also land in various parts of England and the adjacent islands that is in a like manner fitted for the production of potatoes as early, and thereby as you very properly remarked keep the money within our own country?—Yes; I think it would be an admirable thing to discover those spots. I think there are suitable spots in England, which have not been availed of, all round our coasts. I think it is a matter of very considerable importance to ascertain that, and that would be within the functions possibly of the officials. Supposing you have four different points in Ireland, for instance. The official might be employed to ascertain the most available spots.

1651. Even from a cursory knowledge you are of opinion that there are points on the coast at the present moment that could be made available for the production of earlier potatoes than what we generally had in England?—That is quite my opinion

1652. And, therefore, it would be a very desirable matter to obtain information of that kind?—Yes.

1653. Do I understood you to say that you have tried the Dalmahoy potato?—Yes.

1654. Did that potato fail you?—It quite failed in the course of a few years.

1655. In your soil?—In my soil.

1656. You have told us the character of your soil; do you think the same result would follow in any kind of soil?—No; every variety of potato and every plant has a particular soil and climate, which are favourable to its growth; that is very evident to all gardeners.

1657. And to its health as well?—Yes, and to its health as well; if you find out a proper spot, it is much the same as with men, they enjoy better health in one particular altitude than another.

1658. Then, following that, it would be equally desirable that we should arrive at some knowledge as to the localities where the plant would

Mr. *Macdonald*—continued.

be most likely to be most easily cultivated?—Yes; it would be very desirable indeed to ascertain the districts which particular varieties of potatoes affect most; that is an inquiry that has not been pursued very far; but it is one that would help us very much indeed in growing potatoes, and in recommending potatoes for growth.

1659. You think that is a branch of knowledge that would be desirable to be cultivated?—It is very desirable.

1660. We should then discover, by such an investigation, the exact spot where the Champions, the Dalmahoys, the Magnum Bonums (which were rather rudely spoken of this morning), would be certain to succeed?—Yes.

Mr. *Arthur Moore*.

1661. What means can you take in order to bring a given potato, which is not one of the table potatoes, as I may call them, for early use, to produce a crop at an earlier period than its usual time?—A potato will follow its habit; you cannot alter the habit of a potato.

1662. I think one of the witnesses said something about placing the seed potatoes in a warmish room; would that have an effect?—It would make them grow; they would sprout earlier.

1663 That would not bring in the crop any earlier?—No; you cannot make a late potato an early one.

1664. Do you think it important in years when disease appears where the crop has arrived at maturity, that subject to the different works that are going on in the harvest, the potatoes should be dug as soon as possible?—Yes, it is quite advisable; when you are satisfied that the haulm will give no further help to the potato then you may get it up.

1665. Then you think it is prejudicial to leave it any longer in the ground than is necessary in years when disease is present?—It is certainly but of little advantage to leave it in, and there is possible risk.

1666. Possibly, you being a botanist, could tell me where the wild potato is found?—The potato is found in Peru, in South America; my father was Her Majesty's gardener for many years at Frogmore, and at that time I was with him, and amongst other experiments he had some of the wild potato over from Peru which had never been exposed to cultivation. I do not remember the exact district, but it came to us, and we carefully cultivated it, and it was if anything more liable to disease than our own cultivated potatoes, so we were particularly disappointed in that.

Mr. *Round*.

1667. Have you had any experience of foreign seed?—Yes; I have grown seed from Belgium, but not with very great success; potatoes are grown there in very light, sandy soil, and grown in our soil they soon degenerate, and are rather more liable to disease than our own soil.

1668. There is no seed known, I suppose, as good as our seed?—Travellers have told me, and from my own experience it is so, that a well-grown English potato is the best potato in the world. I have tried all the American potatoes, but I have given them all up.

1669. How often do you grow potatoes on the same soil?—I am obliged to grow them every three

Mr. *Round*—continued.

three or four years, but then I do not think it is the same soil because my system of cultivation changes the soil, by bringing up the lower soil, so that in effect I could grow potatoes on the same ground year by year.

1670. Have you grown the Magnum Bonum? —I have not any experience of growing the Magnum Bonum, it is a coarse potato.

1671. Have you noticed disease after thunder storms?—Yes. I find it is almost always developed in heat and moisture, and that quickens the growth of vegetation generally, and especially affects all fungoid growth.

1672. Do you think electricity without rain affects it?—Certainly not electricity without rain. You get no electricity without a humid state of the atmosphere.

Mr. *Colman.*

1673. What year was it you tried these potatoes from Peru?—In 1847.

1674. At that time the disease was very virulent?—Very virulent indeed.

1675. You have not tried them since then?—No, we were so discouraged, and they were bad potatoes as well.

1676. I do not know that I quite understood the remark you made early in your evidence as to the manure you used. You said you used burnt earth and charred refuse?—Well, I burn about 100 loads a year, using all the garden refuse and wood, or anything that will char. Everything is slowly burnt, not burnt red as the farmers often do, but simply charred, so as to make into charcoal a good deal of the vegetable part.

1677. Is there any particular kind of earth you use?—No, it is the surface soil which gets mixed up with it; sods if we can get them, and any surface soil.

1678. It really is a kind of charcoal?—It pleases me the most, mixed separately, burnt earth and charcoal. It is the best possible disinfectant, and there is nothing equal to it.

1679. I have had a similar remark made by a correspondent in Lincolnshire that he finds nothing so good as charcoal, but the difficulty is getting a sufficient supply of it?—In the neighbourhood of woods there would be no difficulty if farmers would save all their hedge clippings; peat, especially where it is properly burnt, forms a capital ash.

1680. That would take the place of charcoal? —Yes.

Sir *Hervey Bruce.*

1681. I think you said you disliked farmyard manure for the growth of potatoes?—Yes; on strong land I do not employ it.

1682. Do you find that you can grow as abundant a crop without it as with it?—Yes, as abundant a crop of good potatoes. The effect of strong manure is certainly to increase quantity at the expense of quality. By giving a potato a manure that suits it exactly, which is potash, I get as good a crop of really serviceable potatoes as if I grew large quantity.

1683. Do you think there would be the same result in a year were there was not much disease? Yes, more results still. A favourable year would assist me very much indeed.

1684. You recommend farms scattered over the country for growing seed?—Yes.

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Sir *Hervey Bruce*—continued.

1685. Would not there be somewhat of a difficulty in that; because unless you had very large farms you would have to grow the potatoes very frequently on the same ground?—Yes, a rotation of crops would be necessary of course. In giving 10 acres I do not presume that 10 acres of potatoes would be grown every year, but it would be divided into three parts perhaps, and other crops grown.

1686. How would it answer do you think, supposing Government officers, in different districts of the country, were allowed to take a field here and there to experiment upon. Do not you think that that could be done as economically, and quite as effectually, as taking a Government farm?—I think not so systematically. It would require a great number of Government officers then, and you would hardly find persons with sufficient experience or with scientific acumen to superintend large areas widely distributed.

1687. Do not you think one experienced officer could, in that mode, go over a considerable district of country?—Well, that is just possible, but then still you would have to employ local people to manage the land.

1688. You think that the season has more to do with the disease than the growth of the potato crop?—Yes, the season has.

1689. You think the disease only occurs within a small space of the year, and that if you can have your potatoes matured before that time of year comes you are safe?—Yes, that is my experience.

Mr. *Storer.*

1690. You have given some very valuable facts with regard to the early cultivation of the potato. Have you ever made any experiments with regard to soot?—Yes, as a stimulant, and being a carbon it is one of the more powerful manures for potatoes. In fact it is difficult to obtain it in sufficient quantities to apply it, but being a pure carbon it is a manure that I recommend in a concentrated form.

1691. And you approve of it?—Yes, I quite approve of it. There is another view which may be taken of the value of those manures, that is, that they are all antagonistic to fungus, and anything that is strongly antagonistic to the development of fungus, and acts as a manure as well, is of double value.

1692. I suppose you sometimes pit potatoes, do not you?—Well, we do, on the farm, but we seldom do in our gardens.

1693. Have you ever tried any mode of prevention of the disease spreading in pits?—I have dusted them with my favourite compound, burnt earth; that I habitually do.

1694. Have you found that act at all as a disinfectant?—Yes, I have stopped the appearance of the vine mildew in the same way, by dusting the houses. I use it in all sorts of ways, and for all sorts of purposes.

1695. Have you ever tried any slight dusting of quick lime?—I have used that.

1696. Have you found that have the same effect?—Yes, that is very valuable, and that is also antagonistic to fungus.

Mr. *Barclay.*

1697. You say you have experimented with soot; at what time, and under what circumstances,

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stances, have you applied the soot?—At the time the potatoes were set, principally; I sow my potatoes on the surface, and they were dusted.

1698. Did you ever try to apply soot to the haulms of the potatoes after they were well grown?—No. I have tried a mixture very much resembling soot. I have tried dust obtained by burning large quantities of wood, and I have dusted the potato haulm when the disease first appeared, and I have imagined that it checked it slightly; but the disease is so penetrating and so quick in its action, that it is almost impossible to reach it by any external application.

699. By wood ashes not in the state of charcoal, but fully consumed, and only the mineral residue left?—Yes.

1700. That mineral residue consists chiefly of potash?—Consists chiefly of potash.

1701. Do you think that pure carbon is of much service as a manure for plants?—Pure carbon is valuable. It has no particular manurial value. It has, on mixing it with soil, a certain mechanical influence, and it reacts, in a way which I can hardly explain, favourably on growth.

1702. Does not soot contain an appreciable quantity of ammonia?—Soot unquestionably contains a certain amount of ammonia, and in so finely a comminuted form that plants may assimilate it.

1703. Is that beneficial effect of the soot, in your opinion, due to the carbon, or the ammonia contained in it?—The ammonia gives the direct stimulus to the plant unquestionably.

1704. Have you ever tried ammonia in any other form to the potato plant?—No, only in the case of guano. I have stimulated occasionally with guano; but I am not fond of applying those very powerful manures.

1705. Do you prefer to grow the potato without farmyard manure?—Much.

1706. If you have not already done so, be good enough to tell us the extraneous manures you employ to raise the potato, or the manure you think most advisable for growing the potato?—The manure I employ generally is, as I have already described, the charred matters; vegetable refuse burnt with a certain admixture of soil, forming altogether a most valuable dressing for potatoes.

1707. Am I to understand you do not care whether you introduce potash or phosphate, but that you depend principally on carbonaceous matter?—There is potash and carbon mixed together in the burnt earth we employ.

1708. That is in the wood ashes you endeavour to get?—Yes; one can hardly say what all these contain. In fact, there is a certain quantity of lime. Our soil is rich in lime; and when that is burnt, that becomes fit for the food of plants, so that I have lime in that mixture, and potash and carbon. I may say that is the manure most favourable to the growth of potatoes.

1709. Then you would also have a small quantity of phosphates amongst that?—Yes.

1710. Do you think it decidedly preferable to use those manures in the form you are fond of, wood ashes, to the form in which you buy them in the market; for instance, as phosphate of lime, bone ash, and muriate, and sulphate of potash, and so forth?—Those manures are so concentrated that they are generally mixed, as you are aware, I dare say, with soil or with coal ash, or with other things, and my favourite manure requires no admixture. I get the same result perhaps.

1711. That is to say, in order to carry out the same policy as anybody who had carbonaceous matter, would the wood ashes in such a form as peat ashes or peat charcoal, properly speaking, answer the same purpose as mixing this peat charcoal with a certain quantity of potash lime and phosphate of lime?—Yes.

1712. Can you give us any idea what quantity you apply per acre?—I can hardly do that; it is applied to so many different quarters at a time; it is dusted thickly over the rows where the potatoes are placed.

1713. About half-a-ton per acre?—Possibly.

1714. What do you consider to be the effect of strong stimulating manure on the potatoes?—Undue development of the plant, and the tuber, and its liability afterwards to disease.

1715. In the first place undue development of the haulm?—Yes.

1718. Does this undue development of the haulm, in your opinion, make the plant more subject to disease, or more easily destroyed by disease?—More easily destroyed; the tissue is attenuated, and it is much more likely to be affected by disease.

1717. Then, according to your experience, a fast growth or large development of haulm is more subject to disease than the hardier, though not luxurious, haulm of potatoes not stimulated to the same extent?—That is my experience.

1718. You endeavour to avoid raising potatoes upon the same soil as much as possible?—Yes; it is advisable to change the seed and the soil; I bring up the lower depth of soil, and that gives a change of soil.

1719. What is the character of that soil on your farm?—The sub-soil is a very strong clay, the soil above being about two feet deep.

1720. And vegetable mould above?—No; no vegetable mould, except on the surface; the subsoil is strong clay.

1721. What is the depth of the surface soil?—The surface soil is about two feet.

1722. What does it consist of?—It consists really of modified clay, if I may describe it in that way; clay which has been many years under cultivation.

1723. Clay modified by the roots of plants?—Yes, and acted on by atmospheric influences and by management.

1724. Do you stir it as deep as two feet?—Yes.

1725. The same reason applies, I suppose, in your opinion, to other crops as well as potatoes, that it is not desirable to grow them more frequently than can be avoided on the same ground?—No, it does not generally apply to plants, because there are very many plants that you must have constantly on the same ground, and they resent any change. With regard to strawberry plants, or any plants like the strawberry plants, with runners, which want to go on a different soil, you must take the hint and change the soil constantly.

1726. What, in your opinion, is the effect of growing the potato frequently on the same soil?—Deterioration in quality and liability to disease.

1727. You have been speaking of experimental

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mental stations; what would be the object, or what would you aim at, in having these experimental stations. Would you have any specific question in your mind to ask by these experiments, or would you make experiments of a general character in order to see what ought to be brought out by them?—It first occurred to me to propose the farms, remembering that the seed potatoes saved by cottagers, generally, are so badly managed and so badly selected, that increased liability to disease results. I think if you provide such people, who cannot help themselves very well, or who have not the knowledge, or the means, at a moderate cost, with sound seed, it would be conferring a national advantage on a class of men who want help.

1728. One object of these experimental farms, which you seem to desiderate, would be to provide a poor class of people with sound seeds?—Yes, that is one of the principal objects.

1729. Have you any idea of discovering anything about the potatoes by these experimental farms?—Yes.

1730. In what direction?—The directors of such establishments should be directed to constantly remark the growth of potatoes, and to select those which show an immunity from disease, or show greater vigour of constitution; just as in the case of the survival of the fittest, and just as in nature you find certain plants survive in the struggle, so with regard to potatoes; all practical cultivators know that occasionally you find a potato that escapes disease, and wherever situated the directors would select potatoes showing such a vigour of constitution as would probably secure beneficial results, as is done with regard to many other things. For instance, our florists get all their varieties by looking out for a chance spray, a promising seedling, or a chance flower with additional petals, and in that way many of the great results in floriculture have been secured; as it has been with floriculture, so it is quite time we turned our attention to so important a matter and applied the same skilful attention to the growing of potatoes.

1731. You are supposing that this intelligent director would have a very considerable amount of scientific and practical knowledge of cultivation generally?—Yes, he would be instructed to employ his powers of observation. In fact it would be equally desirable that individual exercise of discrimination and intelligence should be recommended amongst all growers of potatoes on purpose to select such things. The fortunate man who raised the Champion cultivated a potato he saw was likely to be valuable, but we have done comparatively little in originating good varieties of potatoes considering the immense importance of the crop.

1732. Have not the seedsmen been doing a great deal in that way?—No; there are exceptions, but I believe they generally depend upon gardeners. I do not think seedsmen do much of that sort of thing.

1733. Have you any suggestion to give the Committee as to how the State is going to find these scientific and practical directors to put over these establishments?—No, I have not thought of it sufficiently; it is an idea that only occurred to me this morning. I merely give it you for what it is worth.

Mr. *Barclay*—continued.

1734. You do not suggest there is anything to be learnt by special experiments with regard to finding out a disease-proof potato, or a potato little subject to disease?—Yes, I think that is just the question. It is a very important matter that our eyes should be well opened, and inquiries constantly made, and examination made of potatoes. The worst of it is that everything is left to individual exertion. People either do not know or do not care, and so they go on, and therefore I think it is very important to have a few establishments where the potato is cultivated scientifically and carefully.

1735. Are not there a great many experiments going on privately all over the country in the growing of seeds, and not of the sets?—I am not aware of any.

1736. The Committee have had communications from a great many people who tell us they are growing seeds all over the country?—It is possible. There was a grower, named Pattison, at Dundee, who has made a number of experiments and raised some new sorts of potatoes, but I am not aware of anybody else who was so successful, or who embarked in the experimental culture of seedlings so extensively.

Chairman.

1737. Have you any opinion as to how the disease is carried over from the autumn to the following spring?—Mr. Worthington Smith, a gentleman who has devoted a great deal of attention to cryptogammic botany, has discovered the resting spore, which remain in the ground during the winter; therefore it is always desirable to destroy the haulm; and people who choose to be careful, destroy every portion of a potato that may carry on the disease.

1738. Do you believe in the resting spores?—I do believe in the resting spores.

1739. Do you believe that the disease is carried on by anything that clings to the root itself during the winter; the mycelium?—The operation of the fungi is so very difficult to follow. The spores are so infinitesimally minute, and we know comparatively little of the distribution and the action of these things.

1740. Have you any opinion as to whether the disease is propogated by the atmosphere or not?—In favourable conditions of the atmosphere, with moisture, and heat, and a certain amount of electricity, all fungi are more active, and therefore, if the circumstances that are most favourable occur, then the disease is most active. The thing is produced actively, and the spores float about rapidly in the air.

1741. That is the point I want to arrive at, because the scientific evidence we have had already clashed on that particular point. Do the spores travel any distance do you think with the wind?—I think so. That is my opinion. They travel rapidly in every direction. There are certain centres where the fungus has established itself during the winter, and it appears to me that it spreads from that centre to different parts.

1742. Do you think the spores would go three or four miles with the wind?—I have found, on examining the atmosphere with the aid of gauge-nets, and various things, spores of fungi and moss filling the atmosphere.

1743. You think it could go a considerable distance

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Chairman—continued.

tance?—Almost any distance. A strong head wind would take it any distance.

Mr. *Barclay.*

1744. Have you any experience of destroying fungi on any plant by any application?—Yes, a good deal; we are always fighting fungi.

1745. How do you attack the fungi on apple trees, for instance?—Well, sulphur is the most powerful remedy, or the fumes of sulphur, the direct application of sulphur to any fungus that appears.

1746. Have you ever tried that, applied to the lower surface of the leaves of the potato plant?—I must say I have not; the potato is such a large affair to go over.

1747. Only by way of experiment, I mean?—No, I have not done so. There is one curious circumstance I may remark; I do not know whether I may anticipate some beneficial result from it; but last year the season was very unfavourable to the growth of potatoes, and was towards the close of the season of growth also very unfavourable to the further development of fungi, and in our district we had such cold wet weather that the potato fungus absolutely disappeared. Whether it has entirely disappeared, in consequence of the cold summer and the severe winter, and whether we are to escape in a measure its effects, I do not know, but it is very certain that after a certain period the potato haulm revived a little, and our crop was much better than might have been expected, and began to grow towards the end of the season.

Mr. *Colman.*

1748. From what you have said, in answer to the Chairman, you are very strongly in favour of changing the soil, and not growing the potatoes on the same soil year after year?—Yes; wherever I had the opportunity of changing the soil I should do so.

1749. Wherever the disease is in the soil it would be very important?—Yes, because the resting spores are in the soil, and if you go away to fresh soil it is some little time before the disease finds them.

1750. There is more chance of preserving them than in the old soil?—Yes.

Mr. *Earp.*

1751. You do not think there would be any practical difficulty in the establishment of these small potato farms?—No.

1752. I think we understood you, in the earlier part of your evidence, to suggest that they should be placed under the care of directors, who need not necessarily be themselves very scientific, but who would be in communication with some head authority, who would give a scientific direction?—Yes.

1753. But that they should be more especially persons to conduct observations?—Yes.

1754. And you would recommend that on these farms the object should be the sowing or raising of seed from the plum or pod?—Yes.

1755. And the selection of sets year after year?—Yes.

1756. And the supplying of sound seed to the neighbourhood round or to whomsoever might require it?—Yes; those should be their principal objects.

1757. Are you still of opinion that they might,

Mr. *Earp*—continued.

to a great extent, be made self-supporting?—As far as I have considered the matter, I think so, because there would be a great desire to obtain sets of acknowledged purity, and in a degree free from disease.

1758. Then you would recommend that the Government should simply take as tenants small plots of land in certain suitable localities, and that these establishments should be formed?—Yes.

1759. And you would recommend that that should be done at once, would you not?—Yes.

1760. You think it highly important?—Yes.

1761. You think there would be much more chance of the object which the Committee have in view being accomplished in that way than in any other?—Yes.

1762. I take it that, in fact, the general grower of the potato is so intent on commercial objects or raising seed for his own consumption, that he does not concern himself in your experience with this all-important matter?—No, he does not. There may be a few scientific men who devote themselves to investigations of the kind.

1763. And you have had large experience both amongst amateurs and other persons whose practice is in this direction?—Yes.

Mr. *Barclay.*

1764. If there is a considerable demand for the improved seed, do not you think there is enterprise enough among the gardeners and such like people to provide for the demand?—Yes, it would follow. That sort of thing would pay, and private enterprise does a great deal in England.

1765. You do not think that the market gardeners, for instance, have found out that it would pay as yet?—I do not know that they have made the experiment.

1766. And seedsmen have not found out that it would pay as yet?—I think they have found out that pretty well.

1767. Are they supplying these selected potatoes?—Well, I cannot venture to answer that question. I do not think that any of them are supplying such seed as I should like to see grown on experimental farms. Very often when you buy seed from a seedsman, owing to the injudicious way in which it has been stored, it is of very little value the first year. The potatoes have been crushed together and knocked about, and the eyes broken off, and you have very little result, and until you have grown them a second year you cannot get much result from those potatoes.

1768. Then you hold the opinion that seedsmen do not understand their business?—They understand buying and selling very well indeed, but it is another affair whether the seeds grow and do well.

1769. I thought it was the principal part of a seedsman's business to grow good seed?—It is unquestionably.

Mr. *Macdonald.*

1770. They are more concerned with the profit?—They are more concerned with the profit.

1771. Have you ever tried sulphur with a view of curing the disease of the potato?—No, not directly, because it is not a thing one would care to introduce into the ground.

1772. Have

Mr. *Macdonald*—continued.

1772. Have you ever heard of it being tried?—No.

1773. With regard to the farms which you have spoken so very strongly about; do we know now all we can know about this enemy to the potato, the fungi, that exists?—The life history of the *Peronospora* has been investigated by experts, and I do not know that anything further could be discovered. We know of its existence, we know of its action, and we know under what circumstances it has developed most rapidly; we know of its great disposition for certain plants; but we are not beyond securing plants able to resist it in constitution; that is the only practical point I can dwell upon. That I think is the great point, and that is a gardener's affair altogether; to discover, as in the case of the Champions, a variety of potato capable of resisting disease.

1774. Would not such establishments be usefull also in making further discoveries, if possible, regarding the habits of the fungi, and thereby tend to retard its effect upon the potato?—Yes, such studies would naturally belong to the subject. It follows that they ought to be thoroughly investigated in such places.

1775. There are several points of importance; there is the location of the potato; the development of seed; and the development of the plant and of its enemy, and all that?—Yes.

1776. Do you think that under any circumstances the market gardeners or the seedsmen are likely even to deal with the points that you have spoken to?—Not very likely.

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Mr. *Macdonald*—continued.

1777. Is there any profit in it; can you see profit in following out the experiments which you have adverted to?—It would not be so evident to such men as to induce them to do so.

1778. Is there anything to attract men in the way of profit?—I do not think so.

1779. Therefore it is that you have arrived at the conclusion that is is a matter for the Government to experiment upon, and to put us in possession of the results?—Yes, that is quite my opinion.

Mr. *Arthur Moore*.

1780. I suppose those experiments with the wild potato were not of a very permanent character?—No, but they were grown under very favourable circumstances. The soil in the Royal Gardens was very favourable and good pure soil, and we treated them with all possible care.

1781. You have no notion, I suppose, from reading or otherwise, whether the disease had pre-existed in the potato in Peru, or whether it developed itself in this country?—No, I do not think it pre-existed. We had not heard of any disease.

1782. Then your idea would be that it at once developed itself?—Yes. The great change that took place in the potato, bringing it from a dry warm country to a damp moist one, would render the plant, not being acclimatised, more liable to disease.

Friday, 25*th June* 1880.

MEMBERS PRESENT:

Mr. Barclay.	Mr. Arthur Moore.
Sir Hervey Bruce.	Major Nolan.
Mr. Colman.	Mr. Round.
Mr. Earp.	Mr. Stewart.
Sir Edmund Filmer.	Mr. Storer.
Mr. Macartney.	Mr. Tottenham.
Mr. Macdonald.	

MAJOR NOLAN, IN THE CHAIR.

Professor THOMAS BALDWIN, called in; and Examined.

Chairman.

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1783. YOU are the Superintendent of the Agricultural Department of the National Board?—Yes, I hold that office.

1784. Is the National Board exclusively connected with education?—Exclusively connected with education.

1785. Then, have you no connection with the Local Government Board?—None whatever.

1786. I believe your offices requires you to travel a good deal throughout Ireland?—It requires me to travel once a year in almost all parts of Ireland.

1787. Then you have had an extensive range of agricultural observation?—I have had an opportunity of acquiring extensive information.

1788. I suppose I might say your life has been devoted a good deal to the study of agriculture?—Almost exclusively.

1789. You have, I presume, given a good deal of attention to the potato crop?—Yes. The matter has been brought before me in a variety of ways.

1790. The loss last year was very heavy?—It was enormous last year.

1791. Could you give the Committee an estimate of the loss last year?—I may mention to the Committee that the Registrar General of Ireland, in a special report, has estimated the loss at very close upon six millions. That is Dr. Grimshaw, the present Registrar General. He has gone very carefully into the question in connection with the state of distress, and with my knowledge I am quite satisfied he has understated the case by at least a couple of millions.

1792. Do you think the statistics upon which the Registrar General bases his calculations are accurately given by the cultivators?—I think they are substantially accurate. If one man gives too much another man gives too little. The Registrar General not only gets the total acreage, which is a check upon the agricultural statistics of the country, but he also gets the acreable yield, and I think it fairly represents the return.

1793. You have had ample opportunity of checking these returns from year to year, and you think these statistical returns for Ireland are substantially correct?—I do, and I think his estimate is under the mark, and I stated my estimate of the amount in a little tract which has been published by the Local Government Board.

1794. What would you say the exceptional loss of last year was owing to; first of all was it an exceptional loss?—Certainly, it was exceptional: it was due to the exceptional character of the year. First of all the temperature. The temperature during the principal growing season, which is June, July, and August, was fully, according to returns which have been carefully made out, three per cent. under the average of the preceding 10 years. Then with regard to the rainfall, it is very curious that the average rainfall of the whole year was, practically, the same as in the preceding years, but at the very time the potato disease is likely to be propagated most the rainfall was 100 per cent. over the average of the preceding 10 years. Then the third feature in the climatic condition of the year was the cloudiness of the sky which interfered with the action of the sun light on the crop. That was very remarkable indeed in its character, and largely in excess of the preceding 10 years.

1795. Is it quite out of the control of men of science to contend against the weather in connection with the crops on a farm?—It is certainly very much out of his power. It is quite out of his power to control them altogether, but it is not out of his power to lessen the effects of a bad year. What I call good farming always lessens the effects of a bad year.

Mr. *Macdonald.*

1796. Good farming lessens the effects of the seasons?—It does.

Chairman.

1797. You farm a good deal at Glasnevin yourself, do not you?—Yes.

1798. Could you give the Committee an idea of the amount of tillage that you farm there?—There are 180 acres of land altogether and the bulk of it is in tillage. There are three farms; a little spade labour farm, what we call a one-horse, or a 25 acre farm, as an example for the great bulk of tenant farmers, and our large farm

of

Professor
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Chairman—continued.

of about 150 acres, which we work on what may be called high farming principles, and where we adopt all modern appliances.

1799. How much tillage had you altogether last year?—About two-thirds of the entire area.

1800. How many acres?—About 100 under rotation of crops.

1801. How many acres of potatoes had you?—Twelve.

1802. Were most of your potato crops good at Glasnevin?—The average I take it was on the whole between four and five times the average of the country. Our average was a little over six tons last year to the statute acre.

1803. What was the description of your seed on the potato farm?—The main crop was Rocks, but then we grew 53 distinct varieties altogether in the experimental ground. We have three acres devoted exclusively to experiments.

1804. Could you give the Committee any idea of the per-centages of loss in the different crops you had. I do not mean the 53 varieties, but what was the per-centage in each class of potato?—The White Rock was very largely diseased last year to the extent, in the fields which were highly manured, of 30 or 40 per cent. It varied a good deal with the fields, for reasons I shall presently state to you.

1805. You had other crops, Champions, for example?—We had.

1806. What was the per-centage of loss in those?—The per-centage of the Champions on one part of the farm was not really much above 10 per cent., but it was very small indeed compared with the old varieties.

1807. A wet year favours the potato disease, does it not?—It does.

1808. Do you agree with the scientific witnesses we have had examined here as to the immediate cause of the potato disease; that it is a fungus?—I do fully agree in that view of the case.

1809. Do you think there is no scientific doubt as to what is the potato disease?—None whatever.

1810. It is a fungus, as has been described to us by Mr. Carruthers and Mr. Dyer?—Yes; it is a fungus that can be seen under the microscope as plainly as the potato can be seen with the naked eye.

1811. Amongst scientific men there is no practical difference of opinion as to the nature of the plant or as to its general form?—I have not a doubt that there is not a single man of science, whose opinion is worth attention, who does not take the same view.

1812. Do you think that the fungus plant is indigenous or foreign?—I think it is foreign.

1813. You think it came over in 1845?—I do not offer that opinion dogmatically to the Committee, and I should like the Committee to understand what my own position is before I go any further. I do not want to encroach on the domain of pure chemistry, which belongs to Dr. Voelcker, or upon the domain of botany. My own position in relation to the matter would be more like that of an engineer trying to utilise all sorts of knowledge without professing to be a master of all.

1814. But still your opinion is important; our scientific witnesses, Mr. Dyer and Mr. Carruthers, have differed on that point, though they differ on very few points. What is your opinion; is it an imported disease?—I believe, decidedly, it is imported.

1815. And was imported about 1845?—I think it will be found that it came from Peru in guano. I do not state that dogmatically. I have been for the last 10 years trying to get evidence on that point; the evidence is not conclusive, and therefore I do not state it dogmatically, but I incline to that opinion.

1816. That it came direct from Peru?—That it came direct from Peru.

1817. And not through Belgium, as is popularly supposed?—I think not; but I repeat I do not speak dogmatically on that point.

1818. Do you believe it is possible to extirpate or stamp out the disease altogether?—I do believe it is quite possible.

1819. Practically possible?—I should like to be very guarded in what I say upon that. I believe it is quite possible to do it.

1820. What are the particular means by which it could be stamped out?—Well, I should say very much the same way that foot-and-mouth disease has been stamped out. You must kill it out when you have it, in some way or other; and then if it be a foreign disease you must stop the importation of it if you want to get rid of it. You must kill it out first and keep it out afterwards.

1821. How would you kill it out?—The possible way of killing it out is this: I do not take upon myself to recommend it to the Committee, but I take it upon myself to throw out for the consideration of this Committee whether something may not be done for the purpose of stamping it out in the future. The way of stamping it out is this: in one year to enact that no potato raised shall be planted the following year. I am merely submitting my opinion, and I do so with some diffidence as to the possibility of doing it. If the potatoes raised, say last year, had been all consumed and none planted; if no potato were to be sown in ground which had been cropped with potatoes the year before, or to make certain, say for two years before, and if you imported all fresh seed, I think you would effectually kill it out.

1822. Where would it be possible to import seed from where there was no potato disease. Is there any district where there is no potato disease?—I wish again to say that I do not take upon myself to recommend it. It is now some years since I got myself into hot water. I believe in this very room where I propounded the means of stamping out foot-and-mouth disease and pleuro-pneumonia, and all the boards of guardians in Ireland for the following three months were abusing me. What I advance now, as I said before, I say with diffidence. I merely throw it out for the consideration of the Committee to weigh it, and see if there is any importance to be attached to it; but I think the British Colonies are so extensive, that if the British Government or the British nation decided on doing it, there is no insuperable obstacle in doing it. There certainly is no scientific difficulty in doing it.

1823. On that point we have had evidence from Mr. Carruthers, who, I think, was of a very strong opinion that if there was one single potato plant in the country diseased, that would eventually infect all the others. Could you ever so completely stamp out the disease as not to leave a few potato plants in the country?—That

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was precisely the objection made by many persons to my view originally, with regard to stamping out foot-and-mouth disease. The same objection was raised then that you put now with regard to stamping out the potato disease, that if you left a single beast in the country affected with foot-and-mouth disease then the disease would spread as it originally spread. Therefore, I adopt Mr. Carruthers' view on that point, but I would not leave a single potato in the country any more than I proposed not to leave a single cow in the country affected with foot-and-mouth disease, and there is not, I believe, a single cow now in Ireland affected with foot-and-mouth disease. If you import a fresh animal with the disease then it spreads again.

Mr. *Storer.*

1824. And allow it to travel?—Yes, and allow it to travel.

Chairman.

1825. Do you believe than you can compare the spread of the potato disease with the spread of foot-and-mouth disease, or do you consider that the potato disease is very much more infectious than foot-and-mouth disease?—Not at all as infectious. Personally, I think it is much less infectious, according to my experience of it.

1826. However, to stamp out the disease you consider the great point would be not to save any seed produced in that country in the next year?—That would be one of the ways.

1827. And you would have to go as far as the colonies to get fresh seed?—I would, and I should select those colonies which corresponded as much as possible to Ireland in climate, so that they might be suitable nurseries for the introduction of the plant; and I may state to the Committee that, in my opinion, it would have been the greatest possible blessing to Ireland this very year if every potato raised in Ireland last year had been consumed.

1828. Then you think that the whole of the seed in Ireland was so bad, or the greater part of it, that it would have been a great blessing if it had been got rid of?—I believe it would have been worth some millions to Ireland if that had been done; the seed was so bad. I have seen in every county in Ireland the most miserable seed that you could imagine.

1829. Do you think any experiment could be made in any way in Ireland, or on an island, or in Scotland, in stamping out the disease in the way you suggest as a test?—I do. Even if I do not carry the Committee with me, I should like to say this. You have anticipated a suggestion I was going to offer that the principle could be easily tried on an island; for instance, an island that might be in the hands of one proprietor who might be willing to allow the experiment to be made. I have no doubt many of the large proprietors would give up a small island sufficiently remote from the coast to carry out the experiment.

1830. The island of Arran, or the islands in Galway Bay; would they suit you?—Yes, certainly.

1831. I suppose a good deal of the difficulty of stamping out the disease depends on what is the true theory of how the disease is carried; whether it is carried by the wind, or not?—That is precisely; a great deal depends on that.

Chairman—continued.

1832. Do you believe it is carried to any extent by the wind?—I do not, nor in the air to any extent.

1833. Have you read a good account of the examination of Mr. Carruthers and Mr. Dyer?—Well, I think I have read sufficient. Mr. Dyer's views I have known for some years, for he lived in Ireland, and I have had personal communication with him. Mr. Carruthers' view, I think, I have gathered from the papers, and it would be something like this, that he believes it is propagated mainly through the air.

1834. You are quite right; Mr. Carruthers' idea was, not only that it went through the atmosphere, but that it went immense distances, almost inconceivable distances, and with inconceivable rapidity; while Mr. Dyer, though he allowed that the disease spread a good deal, distinctly said that it did not go by the wind; which view do you agree with?—I agree with Mr. Dyer's view entirely.

1835. But if Mr. Carruthers' view is correct, would you say it is impossible to stamp out the disease by the means you suggest?—It would increase the difficulty enormously, if not render it impossible, supposing he was perfectly right in his view.

1836. Then it would be a matter of the very highest importance for the country to be quite certain as to how the disease is propagated?—Most decidedly; and now that the Government endows research, I do not see any way in which a part of the money spent by the Treasury in the endowment of research could be better applied than in clearing up that particular point, and in testing the soundness of the view I am now submitting to the Committee.

1837. Do you draw any inferences from what has happened with regard to the law relating to infectious diseases in cattle which would bear out your view?—Men, who held as high a rank in science as Mr. Carruthers with regard to animal physiology, stated with regard to foot-and-mouth disease, and contagious animals diseases generally, that they were propagated in the air. Before the Committee, when I first gave evidence, I stated my belief, which was furnished on actual experiment and observation, that that view was unsound. I believe now Mr. Carruthers is mistaken in the view he takes of the way the disease is propagated.

1838. Would you allow that the disease would spread a small distance, such as 10 or 20 yards through the air?—I do not think it is spread in that way at all. I do not see any reason why occasionally it should not be; but not in the way that Mr. Carruthers thinks. I do not see any reason why physically it may not be so.

1839. Would you believe it could go five yards in the air?—I think if it gets in the air at all it may go a greater distance. I think it may be lifted by physical force, but I do not think it is carried in the air in the way that Mr. Carruthers indicates to you, and if you will allow me I will tell you the reason, if I am not anticipating in any way. In order to test that point, I have three times grown imported potatoes near my study, taking every precaution that there should be no germ of disease in the soil in which I grew them. While on the farm round about me, and in one case within about 50 yards of my study, a field of potatoes was hardly diseased, not

Chairman—continued.

not a speck of disease appeared in any of the potatoes that I grew in my room in pots.

1840. Do you know Mr. George Murray at all as a scientist. I mean by reputation?—I know who he is.

1841. I have a paper here which was sent me by Mr. Carruthers yesterday, containing the result of a very important experiment which I should like you to look at after your examination. He seems to have proved by direct experiment that the germs went five yards from a potato field in very large quantities on several successive days. Do you think that would be due to the wind?—I do, if at all.

1842. If it is true?—That is if it is true.

1843. You will read the paper?—I shall do so with great pleasure, because as far as the practicability of stamping out goes, a good deal turns upon that point.

1844. Could you give us any particular method by which the Government could effect this object, that is to say, can you give us a working scheme for testing this point, and also the possibility of stamping out the disease?—With regard to testing the point raised now as to the mode in which the disease is propogated, my own idea is that the most practical mode of procedure would be to offer a large reward, 5,000 *l.* or 10,000 *l.*, to any man who would prove beyond all doubt whether Mr. Carruthers is right, or whether Mr. Dyer is right. I think the interest at stake is so enormous an interest, because in Ireland alone last year the loss was certainly at least 8,000,000 *l.* sterling, therefore, I think, being so big a thing to Ireland, leaving out England and Scotland altogether. that any reasonable sum of money bestowed upon it would be well spent in encouraging a man to elucidate such a point. That is one way of dealing with that question. Then the mode of dealing with the larger question would be this, to appoint, say, a commission of competent men, well known and well tried men, representing different sides of the question, and to place a small island, it need not be a large one, at their disposal. Then let them live on it sufficiently long to investigate the whole thing thoroughly, and let them test, as they can easily test, whether the disease can be stamped out on that island, and concurrently with the testing as to the possibility of stamping out the disease, the commission should be so constituted as to elucidate the other point as to the mode in which the disease is propagated.

1845. How far should that island be from the nearest potato land, or from the next island?—According to my view not very far, not more than a quarter of a mile, or not even so far as that.

1846. And if it was found that the disease steadily recurred in that island, you would say the wind probably conveyed it?—I should be compelled, if the men were properly selected, to alter my own views. Therefore, before dogmatising on the subject, I should really like, in the interests of truth, to see the experiment tried on the island.

1847. What sort of committee would decide, if a large reward were offered, as to whether the theory of the wind was correct, or the other theory; could you name any class of men; would an agricultural society be sufficient?—I do not think so at all. You should have a committee consisting of Sir William Hooker, for example, Sir Robert Kane, who took part in the investigation into the potato disease which took place after the great famine, and a very eminent scientific man, and then a distinguished chemist, say Dr. Voelcker, the leading agricultural chemist in England, who is now in the room. There ought to be, I think, at least, two of the most eminent British botanists, and say one of the most eminent chemists.

1848. Then, as I understand your views of the state of science with regard to the potato disease, they amount to this, that you believe we thoroughly know what is the potato disease, and that it is a particular fungus?—Yes.

1849. But at the present moment there is a great uncertainty as to how the disease is propagated?—I have none whatever.

1850. You have acknowledged that very eminent men take an opposite view?—So they did with regard to the foot-and-mouth disease.

1851. You have no doubt that there is a conflict of opinion amongst scientific men as to how the potato disease is spread; is that the state of science?—Mr. Carruthers has expressed his views long ago, I think. I knew them before he expressed them here at all.

1852. Although Mr. Worthington Smith is in the room, and we shall have his opinion on this important point, still I should like to have your opinion about the resting spores?—Well, as I have said before, I should really like the Committee to know what my own position is. I do not want to step in where distinguished men differ in pure science. I have striven to utilise the working of all. I will state candidly, that I believe all men of science are not recognising Mr. Worthington Smith's investigations; but I am bound to say they impress my mind favourably, and that he has carried me with him as far as he has gone.

1853. You believe in the resting spores then?—I do, but I wish to say again that I do not speak so authoritatively on that as on the point which I am more competent to speak on.

1854. Is not your position a sort of connecting link between that of the men of science and those engaged in practical farming?—Yes, decidedly; that is the position I should like to take.

1855. Do you believe that the disease can rest in a field after one crop, and carry it on to another?—I believe it may rest for a year or part of a season; how long it may rest I am really not in a position to say.

1856. Do you think these resting spores would have sufficient vitality to rest over one year?—Mr. Worthington Smith will tell you more than I can possibly of his own views. There are only two men, as far as I know, who have been working on this subject; one is M. Du Bary and the other is Mr. Worthington Smith, and they appear to me to differ *in toto*. All that we know with regard to the resting spores, and all that has been published which appears to my mind to have gone far towards settling the views of the resting spores, has been done by Mr. Worthington Smith.

1857. I understand that Mr. Worthington Smith originally discovered them, but what I should like to know from you, from your practical acquaintance with the subject, is this: have you observed whether, where potatoes were cultivated

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tivated a second or third time in the ground year after year, the disease is communicated by resting spores to the new crop?—Unfortunately my observation, and the observation of anybody else, would not be worth much upon that without direct experiment, and if I offered an opinion on that point really I should be deceiving the Committee, for this reason, that the disease is so prevalent in Ireland, and you do not know how it all got there.

1858. Returning to the question of stamping out the disease, would it be of any use forcing all the stocks to be burned each year, and destroying the diseased potatoes; would that have any useful effect, or tend to lessen the disease?—It certainly would tend to lessen it; but I think it is one of those things that if you are going to stamp it out at all, you must do the heroic.

1859. Burning the stocks each year would be of use in having a partial stamping out?—I think it is quite desirable, or it would have an effect as far as it goes; but it appears to me the effect would be so partial, that I for one would not be disposed to recommend it.

1860. Have you found that the disease can be mitigated by manures?—I have found that the disease can be mitigated by good tillage, good farming of every kind, and by manure more particularly.

1861. Could you give us any results of experiments you have made in that direction; you have been in a better position to make experiments, I suppose, than any man in Ireland, or probably, I might say, in Great Britain and Ireland?—I have made experiments for the last 13 years on potatoes, and I will give you one of the results which is typical of the others. I think I have said that we have three acres devoted exclusively to experiments, and I have applied all available manures to all crops for some time, and have carefully recorded the results. I will give you now one result, as far as potatoes are concerned. I had five plots of Rock potatoes; to one plot I applied no manure; the yield was 1 ton 2 cwt., 1½ stone to the statute acre. I applied to the second plot sulphate of ammonia, and the yield was 1 ton 8 cwt.

Mr. *Stewart.*

1862. What was the quantity applied?—Three cwt. per statute acre. I should say that the same money's worth of each manure was applied to each plot. Then to the third plot I applied quicklime, and the yield was 2 tons 5 cwt. Then the manure applied to the fourth plot was the crude sulphate of potash of commerce, and the yield was 4 tons 10 cwt., 1 stone per statute acre. Then to the fifth I applied the ordinary farmyard manure, reckoning it at 5 *s.* a ton, and putting on the same money's worth; the yield was 5 tons 8 cwt. per statute acre. Then I pitted those potatoes carefully in small pits, and surrounded them by what I considered to be the very best material for preserving potatoes, and that is stubble. If a piece of land happens to be a little foul, as it often will be, even under the best farming in the world, you scarify it, and get the stubble.

Mr. *Earp.*

1863. Were those potatoes free from disease when lifted?—There was a little in them, but I allowed them to remain a short time in order that the disease might develope itself, and I measured carefully, or made a calculation of the per-centage of disease, and it was as follows in the several plots. Where there was no manure applied it was 6½ per cent., that is, 6½ lbs. per 100 lbs. weight. Where sulphate of ammonia was applied the disease was 12 per cent., or 12 lbs. per 100 lbs. Where quicklime was applied it was 5 lbs.; where the crude sulphate of potash was applied it was only half a pound, and where the farmyard manure was applied it was 17½ lbs.

Sir *Edmund Filmer.*

1864. Were they the same kind of potatoes?—They were the same kind of potatoes, planted the same day, and treated in every way alike; lifted the same day and put under lock and key until the per-centage of disease was decided. In point of fact, all my experience bears out that the richer the manure is in nitrogen the more disease you will have.

Mr. *Stewart.*

1865. But the larger the crop?—Yes.

Chairman.

1866. Then do you think there is any specific value in these manures in relation to the constitution of the plants, or would you attach much effect to those manures as being simply anti-fungus, to kill fungi; take the quicklime, for example?—The quicklime I view in this way, that it liberates, as Dr. Voelcker can explain to you, plant food, that is to say, the minerals in the soil that become plant food. I believe Ireland has been over-cropped with potatoes, and that the same thing has happened to our soil that happened in Cheshire many years ago with regard to phosphate of lime. I believe the potash has been so reduced in the soil that really that is the chief cause why the potato famine of 1848 was felt with such terrific effect in Ireland.

1867. You think it was largely due to a want of available potash?—To a want of available potash in the soil. The evidence on that point that I have accumulated in various parts of Ireland appears to me to be conclusive upon it, and where the crop is grown year after year as it is, and as it is known to you, very often in the same potato garden the potatoes, in a bad year, are sometimes not worth digging. I have had occasion since the 1st of September last to travel through almost every district in Ireland, more especially the distressed districts, in connection with the Royal Agricultural Commission, and I found on the old over-cropped bogs of Ireland the potato in many cases was not worth digging, and I daresay you in the West of Ireland know that too; whereas in all the newly-reclaimed bog and the upper bogs or the fresh bogs the crop was luxuriant, and the proportion of disease was very small indeed. That is so of all the over-cropped land in Ireland. The disease tells with more terrific effect on this soil than on any other soil. The results obtained by the use of quicklime are to be ascribed to the fact that it is not only a fertilising constituent itself, but it liberates other constituents which are more important than itself by its chemical action.

1868. Do you hold that there are only four ingredients you need give crops as a general rule, at any rate, in Ireland?—Yes; they would be nitrogen, phosphate, potash, and lime.

1869. You

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Chairman—continued.

1869. You hold to that theory?—I do so far as we have gone, but I have no doubt in the world that as we grow older, after a time, it may be a very long time, we shall find that other constituents will have to be applied as well.

1870. You consider that of those four, potash has been conspicuously absent in land in Ireland?—I do; in consequence of the large quantity the potato contains, and the continuous growth of the potato in the same ground.

1871. Do you consider that that weakens the constitution of the potato?—I am as clear upon that as that I have now the pleasure of addressing this Committee.

1872. Do you know the coast of Connemara?—I do very well.

1873. What is the soil composed of there; is it decomposed granite to a great extent?—There is good deal of it.

1874. Is it potash granite?—There is a good deal of potash in it; but along the coast there they use very large quantities of seaweed, and seaweed contains potash. In my experiments I have over and over again applied seaweed, and I have found the results very striking indeed. It may interest the Committee to know generally that potash appears to me to have a most beneficial effect on three farm crops, one is potatoes, another is clover, and the third is the bean crop. I may mention that all these experiments I refer to I have made on other farms under my direction, and the results are substantially the same as those I have given. My experience is not confined to experiments on one, two, or even three farms, and to show you what we are doing, it would be almost worth your while, as a Committee to remain sitting till next year, to see what the result is of experiments, which you will find detailed in this paper. I may mention that they are not exclusively mine. They are undertaken chiefly by the County Cork Agricultural Society, and I merely work in their experiments with my own. I believe they will be the most complete set of experiments ever made on potatoes.

1875. What you say is, that except in the form of seaweed, very little potassium has been given to the soil in Ireland?—Very little indeed, except what goes back when the fæcal matters are utilised. Then potash does go back, but an enormous quantity passes off in urine and in other ways, which never goes back to the soil. The drain from the soil of Ireland of potash has been something fearful; I have not brought it with me, but in one of the first essays I ever wrote, I went very carefully into that question to show the quantity that had been taken out of the soil of Ireland. I did not think the evidence would take the turn it has, or I would have brought it with me.

1876. So you think the security of the potato crop for the future will considerably depend on potash being restored to the soil of Ireland in some shape or form?—I believe the judicious application of artificial manures containing the necessary quantity of potash, is one of the means by which the wealth of Ireland might be largely increased through the potato crop.

1877. Do you attach much importance to the change of seed?—I do attach great importance to it.

1878. And you think we in Ireland are conspicuously inferior to the Scotch growers in our method of changing seed?—We are inferior to them, I am sorry to say, in many ways. We do not pay attention to the production of new kinds, and do bestow little or no attention at all on what may be called "selection." I have seen this year seed potatoes in the houses of small farmers. I have been in the houses of about 2,000 of them in different parts inquiring into their condition and the tillage of their farms, and it was something fearful to look at the mere marbles, half grown and half matured, that they were actually using for seed. The result is this, that the average yield of potatoes in Ireland is really not certainly half what it is capable of being. On the small neglected farms all round it is certainly only one-third what it is on well managed farms.

Mr. *Earp.*

1879. What do you consider the average yield should be?—The average in Ireland for the last 10 years is about three tons to a statute acre, according to a Government return, which I take to be substantially correct. That is somewhere about half of what it is on fairly managed farms, where the potato enters into the rotation of crops. I look upon it as a matter of primary importance, that it should not be introduced too often on the same ground. We learn from experience that if clover is repeated on the same ground the land refuses to grow it. Now no sensible man introduces it into his rotation more than once in eight years. Turnips, if repeated on the same ground, become diseased. And likewise the potato for the same reason if repeated too often on the same ground is liable to disease. The average yield in Ireland last year was only 1 ton 6 cwt.

Chairman.

1880. Are there many large growers of potatoes in Ireland; men who grow over five statute acres for instance?—There are several.

1881. But do they grow 10 per cent., or what percentage of the whole crop of potatoes grown by really large growers?—The total area grown last year was over 846,000 statute acres, and therefore 10 per cent. of that would be 84,000 acres. I should say that that quantity would not be grown by the large growers.

Mr. *Stewart.*

1882. Do you mean by the term statute acres, imperial acres?—Yes.

Chairman.

1883. Are the large growers, such as those in the county of Dublin, very much inferior in science and agricultural skill to the Scotch growers?—What I should like to say in answer to that question, fearing that I might be misunderstood is, that I hold there are as well managed farms in Ireland as in Scotland or England. I will venture to say you will find as well-managed farms in Louth and in other counties in Ireland, here and there, quite as well managed as any farms in England or Scotland, but I am sorry to have to add that that is the exception, and not the rule. Now coming to the county Dublin farmers, they really till well and manure liberally, and they do, as a rule, buy fresh seed; that is their practice.

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Chairman—continued.

Many of them adopt this plan, which is what I advise most ordinary farmers and landed proprietors myself to do, namely, to buy as much fresh seed this year, regardless of cost, as would suffice for the entire crop of next year, and that is a rule that applies to corn as well as to other crops.

1884. Then you would say the large growers in potatoes in Ireland are pretty well able to take care of themselves?—They are.

1885. And want no more special help than the same class do in England and Scotland?—They want nothing more. They want to be roused up a little, and I think a good many of them would make a bit of money, as the Scotch growers do, if they paid more attention to selection themselves.

1886. When you came to the small growers, is there an enormous difference between them and the English and Scotch growers of potatoes?—An enormous difference.

1887. Could you describe the general system of the cottier tenants in Ireland with regard to potatoes, as to his change of seed and rotation of crops?—To the small farmer in Ireland of the class which I am sure is before your mind, a rotation of crops is utterly unknown. His farm will consist of a plot of potatoes and a plot of oats, and the greater portion of his little holding will be in what he calls grass, that grass really containing more weeds than grass. He never thinks, as a rule, of changing his seed at all. Take the common oats of the country, a splendid variety, the common speckled oats of Ireland. If it had been cultivated with care, and proper attention bestowed on it for developing it into a variety like any of the ordinary seed, I believe there is no variety of oats so well suited to certain parts of Ireland as that is.

Mr. *Barclay.*

1888. Is that the coney oat?—No; this is an oat peculiar to Ireland; the common speckled oat. It is a hardy kind, and where you select the seed as I have done myself, it is very productive; but then these small farmers never think of selecting at all. They use the very worst, and sell or eat the best; so with regard to the potatoes; they grow the potato year after year in the same bit of land; as a rule they do not change it; as I have said before, there is no rotation of crops. As a rule also, they buy no manure, and they certainly restore none of the potash that has been taken out in the shape of artificial manure; they bestow no attention on selection, and as I have told the Committee already, this very year I saw myself the seed going into the ground, not bigger than marbles, and not half matured. The result must be that the yield cannot possibly be anything like one-third of what it would be if they had had good seed.

Chairman.

1889. When you say they put them down the size of marbles, is that sometimes seed that has been grown in a bog for the sake of getting tolerably pure seed?—It is not.

1890. It was grown in ordinary land?—Grown in ordinary land, including bog.

1891. Do not they sometimes grow potatoes in the bog in order to get them free from the potato disease, and use them for seed?—Some of them do; and I do not mean to say that there are not some of them intelligent; I have met as intelligent farmers in the bogs of Mayo, in fact, more intelligent and better farmers, than I have met in Belgium.

Mr. *Macdonald.*

1892. But in Mayo they are not so general?—As I say, they are exceptional.

Mr. *Barclay.*

1893. What would be the area of those farms you speak of in the bogs of Mayo?—They were from six up to 10 and 20 acres.

Chairman.

1894. Can you suggest any legislation by which there could be an improvement effected with regard to the potato disease in the condition of these small farmers? Could the Government, by legislation, force them to change their seed, or could it offer facilities through Government departments, or the Poor Law Unions? Is there any method you can suggest to the Committee from your own personal experience?—That really is part of a large scheme that I myself have indicated already to the Royal Commission, and which I hope to develope for them. I have no hesitation in indicating to you that something of the kind is absolutely necessary if these people are to live at all. I do say to this Committee, though I hope I am not overstepping the bounds of my duty to the other body, that the only hope for these small farmers is a radical change of management; and the first thing to do to lead them up is to try and improve the potato, because that is their mainstay.

1895. We are confining ourselves to that and with regard to the potato. I wish you would tell us what means could be adopted by legislation, or by Government encouragement?—I am almost unwilling to say it, because so much public money has been already spent in Ireland to benefit this class which has not found its way to them; but I think you must have some new machinery to reach them; there is a means of doing it, and I should be disposed to suggest the creation of some board that would call into active play every element of progress in the country. At present everybody is doing the dog in the manger, and there is really no progress at all.

1898. That is rather getting beyond our scope I am afraid, but I think we may enter into the question of a supply of seed; is there any means by which the Government could force or coax these small tenants to change their seed occasionally?—I think if they continue to lend them money on easy terms for the purchase of seed potatoes, if they can give security for the return of the money, that would be a very excellent idea.

1897. Have you any idea through what machinery the money could be collected afterwards; would you use the poor law machinery?—I think that is the simplest.

1898. You think that is the simplest and the best?—I think so.

1899. And unless Government does something of the kind, do you think these people will practically change their seed?—I do not; I am clear upon that.

1900. Are they the great bulk of the potato producers

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producers in Ireland?—Yes; and the best way for the Committee to realise the importance of that is to bear in mind that out of the 600,000 holdings in Ireland, there are 400,000 not one of which is over 30 acres, and there are 173,000 holdings in Ireland at the present moment, not one of which is valued at more than 4 *l.* a year.

1901. Your argument applies to 400,000 out of the 600,000?—To a very large proportion of the 400,000.

1902. Could you tell us what you think is the present prospect of the crop this year; we should like to have the latest information on that subject?—I have travelled a great deal during the last six weeks in the south west of Ireland, more especially in south-west Cork, which is a very backward part of Ireland; I never saw the potato crop look so promising as this year. I have been every year for the last 14 years, over the same ground, and I have never seen the crop show anything at all like the promise that it does this year.

Mr. *Arthur Moore.*

1903. Have you been about Skibbereen?—Yes; and in several islands off Skibbereen.

Chairman.

1904. Of the total amount of seed put down in Ireland this year, how much do you think has been imported?—Unfortunately, owing to the absence of the statistics of the cross Channel trade which was abolished some years ago, it is difficult to make an estimate.

1905. Can you give a rough estimate?—I am afraid it would be a very rough estimate.

1906. Has a third been imported?—I should say not; there are between 800,000 and 900,000 acres under potatoes this year, and in round numbers, it takes about half-a-ton to the acre; that would be 400,000 tons, and a third of that would be about 130,000 tons.

1907. And you do not think so much as that has been imported?—I should certainly be disposed to say it could not be very much short of a fourth of it.

1908. Now I should like you to tell the Committee what you know about the different varieties of potatoes; what variety of potato have you found to answer best at Glasnevin, and what potatoes offer the best hope for the future?—At the request of the Government I wrote a little tract (and endeavoured to write it in words of one syllable) for the purpose of distribution amongst small farmers by the poor law guardians, and I believe they have circulated some 20,000 copies of it. I stated there my experience on the subject, and very briefly, without naming one-twentieth part of those we have tried; as I have said, we have had a great many well-known varieties. The Champion is the newest kind of all. I am sure you have got abundant evidence of the fact, which was well known to everybody before that the potato, owing to the peculiar way of its propagation by setts, the want of skill and care in selection, and the want of proper treatment, after about 20 years' cultivation, even the best variety shows signs of degeneracy. That fact was brought out a great many years ago by the late Mr. Lawson, of Edinburgh, who did more, in point of fact, to enlighten the public on good varieties of crops of all kinds than any man with whom I am acquainted. He brought out that fact very clearly, and my own experience and observations go in the same direction. The fresher the variety, therefore, the better, and above all I am prepared to state this to the Committee, though possibly you have got better evidence bearing on the same point; it has brought out in the researches of Charles Darwin that when you fertilise one plant with the seed, producing another plant, what is called hybridising; as a rule, you get a much stronger growing plant. He has placed that beyond all doubt, and in my humble way I have repeated the experiments for my own information, or rather I made them before the publication of his great work, and certainly I can bear my humble testimony to the truth of that principle. I do not know any truth more important to impress on the agricultural classes of this kingdom than that they have a mine of wealth themselves at their own disposal, if they will only take the trouble and bring their intelligence to bear on the production of improved varieties of crops; and the production of improved varieties of potatoes in Ireland would be a matter of the greatest possible importance. Take the Champion potato, I have no doubt you have had the history of that from the grower, Mr. Nicoll, of Scotland. I have had no correspondence with him, but I should be disposed to think he used the Rock potato, and, I think, somebody told me he used Pattison's Victoria. In fact, it is a produce of two or three kinds. Its strong growing quality is really ascribable to that, and it is an illustration of the principle which Darwin has placed beyond all doubt.

1909. We have had direct evidence upon that point?—I have had experience of the Champion and with all new varieties carefully selected, and the Champion is very strong growing, and very productive. Like all new varieties at first it was coarse, and there was a great deal of waste in it, as is often found in many new varieties. The Rock and the Scotch Down have sunken eyes, and in peeling them there is a very considerable waste. That also applied to the Champion, and as I say it was coarse. I believe in London it is very little known or appreciated, and for the table it will fine down I have no doubt. I believe it is a variety of potato pre-eminently adapted to the wet climate and wet soil of Ireland, if proper care be bestowed upon it. I think it is quite in the interests of truth to tell the Committee this, and when the report of the Committee comes before the public, I hope it will caution the Irish people above all, against the fearful frauds practised on them under the name of Champions. I know one particular district in which I have got evidence clear and conclusive that White Rock potatoes raised in the district were sent to the neighbouring market town and came back as Champions, under the name of "imported Scotch Champions." There is a variety that I think a great deal of, and it is very well known in Ireland, more especially in the north, the Skerry Blue. In my experiments up to the time the Champion appeared, that resisted disease better than any other kind. It is a wasteful potato, that is to say, the eyes are sunken, and I believe that is the principal reason

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reason why it is not more extensively grown. The Rock did extremely well in Ireland till last year, when it succumbed, but I believe if proper care he bestowed in the selection of the Rock, and if the potato be not introduced too often in the same ground, it is still a very good potato to grow in Ireland.

1910. That is the White Rock?—Yes; the White Rock and the Scotch Down are confounded by most people, but there is really, as the names indicate, a distinction between them which experienced persons are enabled to detect.

Mr. *Stewart.*

1911. Do you know them by the name of the "Protestant"?—The potato we know in Ireland as the "Protestant" is not the same. In the nomenclature of potatoes, like that of all other crops, you will find the same variety, in different parts of the country, known by a dozen different names.

Chairman.

1912. You think the Champion will in time like the other varieties of potatoes, get weaker and weaker?—I think there can be no doubt of that at all.

1913. How would you suggest that new varieties should be produced; how can we ensure having a new variety after the Champion which will be a strong and healthy potato?—The agricultural societies ought to take it up. In Ireland, owing to the poverty of the country, perhaps the funds of the agricultural societies are not adequate to the purpose, but if we had a proper agricultural department I think the Government could come very well to the aid of a poor country like Ireland.

1914. As a matter of fact, do you know whether the agricultural societies have done anything very much to produce fresh varieties?—No; the only attempt made, that I am aware of, on a large scale, was made by the Royal Agricultural Society of England a few years ago. They, through the liberality of one member of the council, made a grant, and tried different sorts of potatoes.

1915. We have had very clear evidence upon that point, and Mr. Carruthers has written a pamphlet on the subject; there were about 20 varieties of potatoes?—Yes.

1916. That is not quite what I meant; what I meant was rather the first production of these varieties?—I do not know any other agricultural society which has done anything, and I do not see why the Government should not make grants, for instance, for the production of new and improved varieties.

1917. Could you do that at a place like Glasnevin; would that be a place where it would be possible to produce new varieties?—There is nothing to prevent it if the staff were adequate.

1918. It would be quite within your department?—Yes. There is one matter with regard to that experiment which perhaps Mr. Carruthers could not enlighten you upon so well as I can. I happened to be the judge who reported for the Agricultural Society on those potatoes, and I visited every farm on which they were grown in Ireland, and saw them measured and weighed, and brought out the results, and it was with great regret indeed I found that the Agricultural Society did not continue that experiment. I believe if they had persevered, and selected the best sorts, and rejected the bad ones, they would have gone very far towards establishing, from the experience I got that year, varieties that would greatly resist disease.

1919. I believe there was one kind that was a partial success out of the 20, and only one; is that your recollection?—That is so.

1920. You think then that the Government could do a great deal towards establishing new varieties, if they were to turn their attention towards that at the agricultural schools?—I do think so.

1921. Would that be a better plan than offering prizes?—I think it would be. I think it is more feasible and more immediate.

1922. How many Schools of Agriculture are there in Ireland altogether?—The principal one is at Glasnevin. There is another at Athy, on the Duke of Leinster's property, which is about being abandoned, and one at Cork, which is about being reconstructed. Then there is a fourth at Ballymoney, in the county Antrim. All the others have been abandoned.

1923. Do you think use could be made of farms of that kind for growing new varieties, and showing people of the neighbourhood how to grow potatoes?—I have no doubt of it at all. I think it could be done.

1924. Would such farms be largely self-supporting?—Well, I think if you go into experiments of that kind it is very difficult to make them pay, and I think if you are going to use these farms as experimental farms, the experimental department ought to be kept perfectly separate and distinct from the ordinary farm.

1925. I suppose for the ordinary farm you like to have a pretty good balance sheet to show?—Yes, and I think it fails to be a model farm if you do not show a proper balance sheet.

1926. And that you could not mix up with your experiments?—Quite so. At Glasnevin there is a scientific staff, a chemist and a botanist, and by a slight modification the work could be very well done, and in the reconstruction of the Cork school the same work could be done there too.

Mr. *Round.*

1927. How do you think the disease is propagated?—It is caused by a fungoid plant. There is nothing exceptional in its general character that is not to be found in the same family of fungoid plants.

1928. How are the fungi plants transferred from one plant to the other?—I think it is transferred in the potato, chiefly in the tuber. I have no doubt it is capable of being transferred in the stalk, and part of my scheme for stamping out would be to demolish the stalk or baulm for the year. I should apply the other remedy.

1929. Could it be carried by birds or other animals from one plant to another?—It may; but in practice, I think it is not to any extent.

1930. And you do not think it is carried by the air?—I do not think it is carried by the air.

1931. Did

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1931. Did you ever see the Red Rook grown?—I know the Red Rock.

1932. Do you think as much of it as the White Rock?—It is a very strong growing kind, but I did not find it so capable of resisting the disease.

1933. And it is not so commonly grown?—It is not so commonly grown, but it is a very good potato, and very much liked for table use.

1934. You stated that the seeds grown last year were of so inferior a quality that you could not anticipate a good crop; and you have stated also that you had never seen a crop presenting so good an appearance as it does at the present moment?—I stated that, on several of the little farms that I visited, I found the seeds so wretchedly bad that the crop from them must be bad. The appearance of the crop now, I need hardly tell you, is no indication at all of what the yield of tubers will be. I merely said that the plant has an exceedingly healthy appearance, and that is chiefly owing to the large quantity of fresh seed used.

1935. You do not know any place where you can get perfectly pure seed?—Yes, you can get perfectly pure Champion seed from Mr. Nicoll, I have no doubt.

Mr. *Stewart*—continued.

1936. They do not always turn out perfectly pure, but the per-centage of disease is very much less in that variety than any other?—It is.

1937. Would not you consider that the large agricultural societies in this country could equally well carry out these experimental farms, or could better carry out these experimental farms than any department of the Government?—My own idea on that point, and I have had a good deal of experience, is that a combination of both is best.

1938. Do you think the same attention would be paid to it on the part of the Government?—I will repeat for you the experience I have had now. I have seen the working of agricultural societies as long as I remember to have been able to make observations, and I have had a great deal of experience of Government departments, dealing with agriculture and other matters; and I have come to the conclusion that a combination of both is best. The one could assist the other, and, with that view, I may mention that in the Cork Agricultural School, which is to be retained, there is a sort of co-operation between the Government and the local agricultural body.

Dr. AUGUSTUS VOELCKER, PH.D., F.R.S., called in; and Examined.

Dr. *A. Voelcker,* PH.D., F.R.S.

Chairman.

1939. YOU hold, I think, a scientific position in connection with agriculture?—Yes; I have been for the last 25 years consulting chemist of the Royal Agricultural Society of England, and before that I was attached to the Agricultural College of Cirencester as professor of chemistry.

1940. We know you have entered largely into the question of the chemistry of soil and of plants?—Have you also turned your attention to potato disease?—Yes, I have.

1941. Directly?—Yes. I remember that the first outbreak of the potato disease was the year after I came to England. I managed at that time the laboratory of the late Professor Johnson of Edinburgh, and for more than six months I did nothing but analyse diseased and healthy potatoes; all varieties of potatoes; and at the end of it we found that we could make neither head nor tail of the whole affair, and the Professor gave great dissatisfaction to the Scotch farmers; they were very wrath with him for not being able to find out the cause of the potato disease which, I believe, we have now found out. That was in 1848.

1942. Do you still agree as to what the potato disease is; that it is the fungus?—Yes, I believe there cannot be any doubt about it, that it is the *Peronospora infestans.* All scientific men agree in that.

1943. I should like to get your opinion on what may be called the contested points; do you believe in the spores being carried by the wind a considerable distance?—Yes, I believe they may be carried by the wind.

1944. In fact, you share Mr. Carruther's views on that subject?—Yes, I share them.

1945. And about the resting spores?—With regard to the resting spores, I agree with him.

1946. You agree with Mr. Worthington Smith about that?—Yes, I believe we have very clear evidence on that point.

Chairman—continued.

1947. Your attention has been chiefly turned, I believe, to the chemical constitution of plants and of soil and manures?—Yes.

1948. Could you tell us what are the leading features of the mineral constitution of the potato, and how it affects the question of potato growth?—You may have the potato disease when you apply everything in the best possible form and in abundance; that is to say, you may apply any kind of manure, whether good farmyard manure or the most approved mixtures of artificial manuring substances, and still have the potato disease in a field. The experiments which the Royal Agricultural Society instituted a few years ago were decisive on that point; but at the same time there cannot be, I believe, any question about the fact that under good cultivation, early cultivation and proper supply of all the necessary food constituents of the potato crop, the power of the plant to resist the attacks of disease may be greatly enhanced. We can do a great deal, I believe, by good cultivation and proper supply of manures, in mitigating the potato disease. I may add that the early supply of manure to the potato crop is of very great importance. I have made a good many experiments on the potato crop with a view of ascertaining how the produce could be raised, and I have found that when the manure is applied early in spring, so that it becomes thoroughly part and parcel of the soil in which the potato is grown, the effect is superior to what it is when the same manure, or the same manuring mixtures are applied later in the season.

Mr. *Stewart.*

1949. That would apply to the ploughing-in of farmyard manure when used on the stubble?—Yes, and of any artificial manure which is used before the spring, before the seeds are planted.

1950. Would you cover the artificial manures in, or would you leave them on the surface?—

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No, cover them in and got them as much distributed as possible with the soil. There must be time allowed for the mineral constituents to be thoroughly changed in the soil. We know, as a matter of scientific interest, that the form in which plants take up their food is not the crude state in which we apply it. Take, for instance, the case of potash. If you apply potash in the month of April for the potato crop it is practically of no effect whatever. We usually apply to the land a cheap salt of potash, the crude potash salts which are very largely imported from the north of Germany, kainit or crude potash salts; and if you apply them in the autumn they undergo a series of chemical changes, the potash gets fixed in the soil; other constituents pass into drainage, which are considered of less importance, and then you get the potash not so soluble as to injure the crop nor so insoluble as to be ineffective. You obtain the necessary element, potash, in a condition much more favourable to the healthy growth of all plants, not only potatoes, than you obtain it by crude application.

Chairman.

1951. Would you say that what you have stated about the time of applying potash applies to seaweed?—Yes, to seaweed too.

1952. Should seaweed be applied in the autumn?—In the autumn.

1953. Not during the spring season?—No, I should prefer it in the autumn.

1954. Do you consider that potash is specially necessary for potato culture?—Not more specially necessary than it is for any other crop, for wheat or turnips; the fact is that all green crops take a very large proportion of potash out of the soil that has to be supplied in some shape or other, in the case of light soils especially. In my experiments I have found that in heavy clay soils, the result of the disintegration and decomposition of grantic felspatic rocks, the potash has no effect, whereas in any light soils the effect of potash, or salts of potash especially, is very marked, provided that the other constituents are put on the land at the same time. I have some experiments which show this in a very marked degree. For instance, I have before me some experiments which for several years I had carried on at Lord Wenlock's farm at Escrick, near York. The produce without manure was 6 tons 7½ cwt. of potatoes per acre. Then with potash salts and mineral superphosphate; in that experiment I did not introduce any potash alone; it gave an increase of 1 ton 17½ cwt. in round numbers.

Mr. *Earp.*

1955. With the same potato?—With the same potato sown in the same field side by side.

1956. What potato was that?—That was the Victoria; when ammonia was added, and the same quantity of mineral superphosphates and potash, the increase was raised to 5 tons 13 cwt. 84 lbs. You have here an example showing that in order to get a maximum produce and also a healthy crop, you must not depend on the supply of one constituent; in one case potash may be the most important one, because the most efficient; but as a rule I find that potash salts by themselves do not produce a very marked effect. They produce a greater effect when used in conjunction with phosphate of lime in some shape or other, either dissolved bones or mineral superphosphate, and they produce still better effects where they are applied in conjunction with phosphate of lime and ammonia.

Chairman.

1957. What would you say is the converse of that; take the case of soil in Ireland where phosphate of lime and ammonia have often been applied, and potash has never been practically applied, what would you expect to be the state of the potato crop there?—I should quite expect that the potato crops were liable to catch the disease.

1958. Are you at all acquainted with the mode of culture in use by the cottier tenants on the small farms in Ireland?—Yes, I am; I have been over there several times.

1959. Would you say they ever do apply potash there?—No, never.

1960. Do you think there is a great want of potash manure, and would it be very useful for them to apply potash manure on their farms?—Yes, it would be very useful to them, more especially as they have not a superabundance of ordinary dung. In Scotland all potato growers use a large quantity of ordinary manure, which supplies a very large proportion of potash.

1961. Would you say that in Ireland potash is more conspicuously absent than the other manures in the culture of the small farmers?—I believe that is the case in small farms, and we find even on the Continent just the same where there are small farms, it is there the potash produces a very marked effect. On large farms where the more intelligent farmer keeps much stock, and produces as a necessary consequence, much dung, the effects of salts of potash are not so conspicuous.

1962. You think where there are small holders it is most necessary to add artificial potash?—I think it is; and in many cases the crop, I believe, would be doubled, as in the example I have mentioned, and I have known instances in which the produce has been increased by a limited supply of artificial manures to a greater extent than by a dressing of 20 tons of farmyard manure.

1963. What do you think of seaweed as a manure?—It is very good manure for potatoes.

1964. Have you read the experiments of Mr. Ville?—Yes.

1965. Do you agree with his conclusions as far as the potato crop is concerned?—In a general way.

Mr. *Round.*

1966. Will you tell us the number of pounds of potash wanted per acre?—I cannot give you the exact figures to-day, but I will furnish them afterwards.

Mr. *Stewart.*

1967. Perhaps at the same time you will put in the different quantities of potash, phosphate of lime, and sulphate of ammonia that you recommend per acre?—As a rule I have found excellent results from 4 cwt. of mineral super-phospate, which will cost you about 15*s.*, and 3 cwt. of potash salt.

1968. That is kainit?—Yes. That would cost 8*s.* Then 2 cwt. of sulphate of ammonia, taking it an average price of 18*s.*, would be 36*s.*; so that it would cost nearly 3*l.* In many instances when I have applied this mixture I have more than doubled the crop; raised the produce from 6 tons to

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to 12 tons. I need not say that that paid remarkably well.

1969. Did you apply that the year before you sowed the crops?—Yes, I should apply the whole of it.

1970. You would mix that?—I should mix the manure and apply it as early in spring as possible, as soon as I had got the ground ready.

1971. Supposing you turned up your land in the autumn, would you apply it then?—Yes.

1972. Even before winter?—Even before winter. Potash is not liable to be washed out of the land, neither is the phospate of lime. The phospate of lime becomes fixed in the land, although you may have applied it in the shape of soluble phospate of lime. The only risk you run is that in very wet weather some of the ammonia may be washed out.

1973. You do not recommend this Peruvian guano for potatoes?—Well, it is more a question of price; whether it is cheaper than the other. I believe this is a cheaper mixture than Peruvian guano, and you apply it with greater certainty; but there is nothing in Peruvian guano, as has been erroneously stated, which is calculated to engender potato disease.

1974. That would be owing to the very rapid growth of the potato crop?—That is not the case, I believe.

1975. Have you looked over the evidence which has been already given on this question?—No, I have not; I know, in a general way, what the evidence of Mr. Dyer is.

1976. Would you say that using the artificial manures mainly is a preventive against disease?—No, I do not think it is.

1977. Then what you recommend it for is in order to ensure as large a yield as possible?—Yes, as large a yield as possible, and a manure which supplies all the constituents in the proper proportion.

1978. That manure which you have suggested would be applied, I take it, together with your farmyard manure?—That might be applied or let alone; in the case of applying farmyard manure the quantity which I have mentioned would be amply sufficient.

1979. In how many tons of farmyard manure to the acre?—In 20 tons to 25 tons.

1980. Then have you any practical suggestions to make with regard to staying the extension of the disease, and the best means of diminishing its frequency?—It appears to me that every precaution should be taken to burn the haulm of the potato, and clear away what you can by burning, so as to destroy as much as possible all the resting spores, and then to introduce a proper rotation of crops, not to cultivate the potato crop too much in succession, and also to encourage the growth of new varieties which are known to resist more than old established varieties the effects of the potato fungus.

1981. Are you hopeful that in time, by scientific means and by due selection of seed, by better cultivation, well drained land, and by using judicious manures, we shall get rid of the disease?—Well, I cannot say that I am. I think we shall most probably always have the disease in a modified form; it will make its appearance. Perhaps some years we may be free from it, and then in other years it may make its appearance again. I do not think we can entirely get rid of it.

1982. That is very much owing to climatic changes?—Yes.

1983. Then you would not be prepared to go as far as the last witness, and say that by stamping out the disease and importing seed free from disease, you could hope to obtain a potato crop free from disease?—I am afraid I cannot go so far. I think we may very much mitigate it by a rational proceeding like that suggested by Professor Baldwin, but I do not think we shall get entirely rid of it.

1984. Do the experiments you have made with regard to the potato crop give you any new views on the subject of extirpating the disease?—No, there are the researches and investigations which have been made by Mr. Worthington Smith, and Dr. du Barry, of Strasburg, which show there are great difficulties in the way, because the resting spores may remain in the land for a long time.

1985. More than a year?—More than a year; and under favourable circumstances they may spring into life again.

1986. Do you believe they can remain in the ground four or five years?—I have no experience on that point. That is more a botanical question which Mr. Smith will perhaps be able to enlighten the Committee upon.

1987. Have you ever tried the effect of using disinfectants, such as petroleum, to smear the potato with in order to avoid the disease in the tubers?—I have not, myself, made experiments on that point, but I have followed very closely all the remedies that have been suggested with that view, and I find that on looking carefully into the matter they have all failed, but I have not made, personally, any experiments on the point.

Mr. *Arthur Moore.*

1988. Do you believe the disease is propagated principally by the resting spores remaining in the land?—I believe so, principally.

1989. You do not believe much in the transmission of the disease by the wind?—Well, yes, I believe the wind may carry the resting spores, but not principally, perhaps.

1990. You are rather inclined to agree with Mr. Carruther's view than with Mr. Dyer's, I think?—I confess I do not see so great a difference of opinion between the two. It is more a matter of degree than of kind.

Chairman.

1991. The difference was very strong about the means of infection. They agreed about all other scientific points, but I do not think anything could be stronger than the difference of opinion on that point?—That is as far as I have understood it; I have not read the evidence, but that is my impression.

Mr. *Arthur Moore.*

1992. Do you believe that any electrical conditions of the atmosphere have any effect on the disease?—No.

1993. You do not believe in that?—No.

1994. It seems to be pretty well established that disease has often been perceived for the first

Dr. *A. Voelcker*, PH.D., F.R.S.

25 June 1880.

Mr. *Arthur Moore*—continued.

first time after a thunderstorm; that has been often stated; but perhaps you would be more inclined to believe that that was more owing to the wet than to any influence connected with thunderstorms?—Yes, the wet, and the saturated condition of the atmosphere; moisture, and rain, and heat.

1995. Do you know anywhere where the potato grows free from disease absolutely?—No.

1996. Of course the Champion is a strong type and is comparatively free; but do you know any potato in any part of the world which grows free from disease?—No.

Mr. *Colman*.

1997. Do wood ashes used as manure owe their virtue to the presence of potash in them?—The presence of potash and phosphate of lime, and very good manure it is for potatoes.

1998. What is the best artificial manure to take the place of wood ashes?—A mixture of super-phosphate of lime and kainit.

1999. What is the chance of getting a supply of those?—Both can be obtained in unlimited quantities.

2000. And at a moderate price?—At a moderate price.

Mr. *Earp*.

2001. I think we understand that you attribute very great importance to the admixture of the manure with the soil before the plant is placed in the trench?—Yes, I do attach very great importance to that.

2002. And you would consider it a great mistake agriculturally to open a trench and place wet farmyard manure in it, and then to place the sets in the trench and cover them over?—I think that would be prejudicial to the set. I should not like it.

2003. May I ask you whether you know if there have been any experiments which have gone to analyse the sorts of potatoes continuously used, so as to record evidence of any change in the constituent elements of the potatoes which have indicated deterioration; I mean continuously?—I quite understand your meaning. No, we have no experience on record, but we know, as a general fact, that if the same variety of potato is cultivated on the same description of land continuously it deteriorates. The starch becomes less and less, and finally the potato becomes diseased. On the other hand, if you have a good variety that resists more than another the attacks of the potato fungus, you find in that invariably a larger proportion of starch which indicates early maturity; and in many cases a potato crop may be saved by getting early maturity, in other words, healthy development. If you withhold one necessary element of food the consequence is that the whole plant becomes abnormal and grows slowly; and then when we get early summer rains we have all the elements given for bringing these spores of the fungi into life again. Yesterday I took out a paper which records some experiments of Baron Liebig carried out in 1864 in Bavaria, and there is one sentence which is very much to the point, which perhaps the Committee will allow me to read. He instituted a number of experiments upon potatoes with the view of

Mr. *Earp*—continued.

seeing whether there was anything to resist disease, and he says:—"It follows incontestibly from these experiments that the conditions which favour the normal development of the plants are precisely those which ward off the disease; and hence, as whatever external harmful influence there might have been acted equally upon the plants of each plot, that the proximate cause of the destructive malady is to be sought for in the soil." Or rather, he means the condition of the land, whether it be exhausted, or badly cultivatated, or well cultivated. "Whereever the soil furnishes in sufficient quantity and proper proportions the elements required for the structural development and active working of the plant, then the plant obtains thereby a power of resisting noxious influences from without sufficient entirely to obviate their bad effects." I quote this not that I entirely agree with it, but it expresses a truth which ought to be accepted in a modified form.

2004. Have you any idea how long the resting spores may slumber?—I am informed by botanists for years.

2005. So that the fact that the outbreak of the diseases may become unfrequent would not necessarily indicate that it is about to die out; the resting spores may still exist if the conditions were favourable for their manifestation and development?—No; I believe it never died out from its first appearance.

Mr. *Storer*.

2006. We heard from another witness, that it appeared in the first instance in Europe, in the year 1844; did you pay any attention to the origin of the disease, or the way in which it spread in the first instance?—Not in the first instance.

2007. The same witness told us that it appeared in Belgium first, then after a few days in the Isle of Wight, and then in a few hours it spread over England and Wales?—I believe that is the fact.

2008. Does that agree with your idea, that it may be spread by atmospheric causes?—I believe it is spread by atmospheric causes.

2009. Then it might come from a great distance?—It might.

2010. Do not you think in the case of the very small holders in Ireland, who depend almost entirely on the potato for their subsistence, that to depend entirely on a crop of that nature is a very dangerous thing for the population?—A very great danger; much more so than in a well cultivated farm, because the crop is so much more liable to catch the disease, if I may so express it.

Chairman.

2011. With regard to the sources of potash, have you said what you thought was the best commercial source of potash on the whole?—The best commercial source is kainit, and that can be obtained now at 2 *l*. 10 *s*. a ton in any quantity delivered in England. It is retailed for 3 *l*. a ton.

2012. How much potash does that contain?—It contains what is equivalent to about 26 per cent. of sulphate of potash. It is chiefly present as sulphate of potash, but there is also a little chloride of potassium. That is the cheapest source.

2013. And

Chairman—continued.

2013. And you are quite certain that it would be a matter of great importance that the small farmers in Ireland should use some potash?—I am sure of it. It would have a very beneficial effect. It would pay over and over again.

2014. You give that recommendation more strongly than the use of any other chemical manure that you know of at the present moment?—Yes, provided it is added to others, and not used alone. You must not depend upon the potash alone; but I believe it is most essential to bring out the effect of the others. I have experimented on that point on light sandy land, and I find that potash alone did not do so much good; it produced some effect, but comparatively little. On the other hand, the exclusive supply of superphospate produces comparatively little effect. But on mixing the two together the effect was very good.

2015. Have you any suggestion to offer in the way of legislation or Government encouragement of any plan for lessening the disease?—The only suggestion I would make is to encourage, as much as possible, practical experiments.

2016. In what direction?—Either on established farms or experimental farms.

2017. In what way, on the seeds or on the manures?—On the production of new varieties, and with regard to the general mode of culture.

Tuesday, 29th June 1880.

MEMBERS PRESENT:

Mr. Barclay. Sir Hervey Bruce. Mr. Colman. Mr. Earp. Sir Edmund Filmer. Mr. Macdonald.	Mr. Arthur Moore. Major Nolan. Mr. Round. Mr. Stewart. Mr. Storer.

MAJOR NOLAN, IN THE CHAIR.

Mr. HENRY THOMPSON, called in; and Examined.

Chairman.

Mr. *Thompson.* 29 June 1880.

2018. I BELIEVE you are a Preserved Provision Manufacturer residing at Islington, and you have volunteered to give evidence to this Committee?—Yes.

2019. You formerly grew as a market gardener and farmer a considerable amount of potatoes?—Yes, early potatoes for market.

2020. Did you grow early potatoes exclusively?—Yes, mostly.

2021. Did you grow others too?—Very few others.

2022. Could you tell me by what date the early potatoes were off your ground as a rule?—We commenced sending them to market on the first Friday in July; they were principally Shaw's, Dalmahoy's, and Myatt's Prolific.

2023. At what date had you the crops off the ground?—I could not give you the exact dates, but we commenced as a rule the Myatt's Prolific first, following those with Shaws, and then the Dalmahoys.

2024. When were the last dug?—I should think about the end of August.

2025. Notwithstanding your clearing the ground so early, you have suffered some years from the disease, have you not?—Yes, in 1872, very severely.

2026. At what date did the disease show itself to any considerable extent?—I have not the exact dates, but it would be the latter end of June or nearly the 1st of July.

2027. The disease showed itself very largely in some cases so early as that?—Very badly.

2028. What is the largest per-centage you have ever lost?—I should think 50 per cent.

2029. Then do you consider these varieties of potatoes were particularly susceptible to the disease, or did you try to get hardy kinds?—Our object was always to get early potatoes, so that we could follow on with vegetables for the market, to plant them almost immediately after.

2030. Did you manure very highly?—Very.

2031. Did you use any artificial manures?—No; all farmyard manure, and that we carted from London; horse manure and refuse.

2032. Did you use any sewage manure?—None.

Chairman—continued.

2033. Your attention was then very much turned towards the potato disease?—Yes, in this particular year, 1872.

2034. And you think it would have increased your profits a great deal if you had been able to grow potatoes without disease?—Yes.

2035. Have you ever tried to grow potatoes so as to insure them against disease?—Yes, every year since.

2036. And you consider you have succeeded?—I have succeeded.

2037. I believe that you do not wish to tell us anything about your process for saving the potatoes, but would you kindly tell us how many years you have been growing potatoes insuring them against disease, and to what extent you have succeeded?—I commenced in 1873, the next year, on a piece of Dalmahoys; I took half a rood, and they were sound, except the few that were joining on to the others. It was on a piece of about three acres altogether, and they were quite sound, except a few growing close to the others, which were badly diseased.

2038. In 1874 did you repeat that experiment?—I left my farm in 1873 to take a larger one, but there was a Chancery suit pending so I did not take it, and I have not had a farm since.

2039. Then you only experimented in one year, 1873?—On the farm; but in the garden I have experimented every year.

2040. To what extent did you experiment in your garden?—On a piece as large as this room, or a little larger.

2041. That would be about 200 square yards, I suppose?—Yes; I should think a little larger than this room. I experimented on two or three separate pieces.

2042. Did you carry on the experiment in the two ways; did you have a piece which you did not subject to your process or plan in the same garden with those you grew in your own fashion?—Yes; I have always done that on purpose to prove it.

2043. Had you ever diseased potatoes amongst those not subject to your process, at the same time that the potatoes grown subject to your process were free from disease?—I had.

2044. Could

Chairman—continued.

2044. Could you give some account of these experiments on a small scale?—I can only say that I have planted Dalmahoys, Regents, Victorias, and Myatt's Prolific, to prove that I can grow any sort of potatoes free from disease. Others I have planted in the ordinary garden fashion, and those have been diseased.

2045. Alongside the others?—No, not alongside; spaces between of cabbage or peas, or something of that kind.

2046. But in the same garden?—Yes.

2047. How many years has that happened?—Six years in succession; this will be the seventh year.

2048. So that now you consider you have a specific for the potato disease?—I have every reason to think so. I cannot come to any other conclusion.

2049. I do not want to find it out, but you do not think this plan patentable, so that you can patent it in the ordinary fashion?—I have tried, and I cannot.

2050. It is not patentable?—No.

2051. Now, I suppose you are anxious to have your plan tried on an extended scale?—Yes.

2052. Have you made any offer to the Government, or to the agricultural societies, to grow potatoes in one of their fields or gardens?—Yes. I made it to Mr. Jenkins, the secretary of the Royal Agricultural Society.

2053. They would not go into your plan, I suppose?—No; he said he could not entertain it; and then I tried with the Market Gardeners' Association, and I found I could get on very nicely with them.

2054. They did try it?—I thought of trying it with them, but I had an interview with the secretary, who is a friend of mine, and he failed to see how to go into it.

2055. Would there be any expense in trying your plan?—None whatever.

2056. The potatoes would pay themselves, I suppose?—Yes.

2057. I hardly know how to ask you more questions, because I do not want to find out your secret; but I suppose you would be always willing to try it if the Government would give you a couple of acres of ground?—Yes; I would go down at my own expense and try, either to the north or south of London, on two separate soils.

2058. You would plant them, and have them to sell?—No; I do not sell potatoes now. I wish to prove that it is so, and I have some growing this year that I could show to any gentleman who likes to come to see them.

Mr. *Macdonald.*

2059. Have you tried the Champion potato?—I have not.

2060. You mentioned four sorts, and amongst them the Regent, I think?—Yes; the Regent is grown on the farms. We like to get something always to make up the wagons with.

2061. The Dalmahoy?—Yes; more particularly the Dalmahoy.

2062. Do you find that potato grows well in this country?—Very well indeed.

2063. Near London, I suppose?—Yes.

2064. In a dry, sandy soil?—Fair soil. It was good soil we had at Dagenham, where I farmed.

Mr. *Macdonald*—continued.

Mr.
Thompson.

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2065. Then it grows freely here?—Very freely.

2066. As a rule, without being experimented upon as you say, is it as free from disease as any of the potatoes grown here?—I think, in the way the market gardeners grow it it is, because they get it very soon, so as to follow on with green crops. They get the land frequently cropped, and do not let them ripen.

2067. What time do you plant?—In March.

2068. Early or late in March?—As we can get the land and the men; but we take March as a general planting time.

2069. You have the whole planting completed within the month of March?—Yes.

2070. Have you found it to resist the frost quite as much or a little more than other potatoes?—I cannot say that I have. I have had them very badly cut with frost, sometimes.

2071. Do you know the sex of that potato?—I do not.

2072. Supposing, as you state unequivocally, that you have discovered a remedy, would you object at all, in proof of that, to grow or to superintend for some time the growing and planting of potatoes without giving to the world the knowledge?—Yes; I am willing to go into any arrangement of that kind.

2073. For a couple of years or so?—Yes.

2074. If you took one year you might get a very bad season, so that you would not get a good result?—If we had adjoining fields, and they were diseased and mine were not, I presume that would be sufficient proof.

2075. As you cannot patent your discovery you wish to sell it?—I wish to be paid for my trouble, that is all, in some way or other. If gentlemen like to make any arrangement with me that is possible to be made, I should be pleased to take 10 or 20 acres of land in the ordinary way and grow them right through the season; any description of potato and any soil.

2076. You are prepared to grow any description of potato?—Yes, any sort of potato you can introduce in any soil, provided it is well farmed and well drained, and they shall have my superintendence from the beginning to the end, and I will produce them sound.

2077. You would require a farm placed in your own hands, and to have the superintendence of the whole planting and everything of that kind?—I could not keep it secret after I had the men and horses all at work. An arrangement might be entered into with me beforehand, or I should be able to take your words; I should be quite satisfied with that.

2078. You are quite willing to enter into an arrangement whereby this can be given to the public?—Yes, without any cost or charge, I will go down and superintend the whole of the farming, not too far from London to take me from my business, but within a reasonable distance of London, north, south, east, or west.

2079. I do not know whether I am right in asking you this, but if I am not right do not answer it. Supposing that an arrangement was entered into of this kind, that if you proved successful you should be paid, and if not successful you should not; you would stake the payment upon the result?—If I injured the crop I would pay for the damage done by myself, and give my time free.

Mr. *Thompson.*

29 June 1880.

Mr. *Macdonald*—continued.

2080. I will put it thus: you can answer or not, just as you like; supposing you were to receive 1,000 *l.* (I put a small sum, or that which may be a small sum as you see it) and the 1,000 *l.* were to be put into the bank to await the result. Are you so confident of your skill in having found the true remedy, that you would await the result with confidence that you would receive the money?—Yes; I have offered that to the Secretary of the Royal Agricultural Society. I proposed to go on two farms, north or south, or east or west of London, taking something like 15 or 20 acres (I cannot recollect the exact terms of the offer), and to take any kind of potato that he might choose, and I would go through the whole process of growing from the beginning. Before I commenced that, I proposed he should put 10,000 *l.* into the hands of the Lord Mayor, or some stakeholder, and if I carried out what I said, the money to be paid to me, and if not, to be returned to those staking the money. I then proposed to go a second year in case disease did not exist, to prove what I said to be the truth, but Mr. Jenkins said he could not see how to go into the matter at all. That is the proposition I put before him, and I thought it a very fair one.

Chairman.

2081. What would be the additional cost per acre of your plan?—I think no additional cost; none whatever.

2082. Is there anything else you would like to add to your evidence?—I can only say that I should be pleased to enter into any arrangement. I should be able to show it to you on a small plan in my own garden; potatoes free from disease, besides those that will be diseased in the ordinary course. I think that a very fair test on a small scale.

Mr. *Macdonald.*

2083. Is your garden an inclosed garden?—Yes, with low walls about 4 feet high.

2084. What is the area of the garden?—I should think it is about 500 feet long by about 200 feet broad.

2085. Then the area is inclosed within those walls all round?—Yes; we take the middle bed for the potatoes. There is a large bed running through the centre, and we take that for the potatoes.

2086. That is entirely free from disease?—No, I cannot say so this year; it has been.

2087. Under your process it has been?—Yes, and I had a path between those growing free from disease, and those growing diseased, and they have been perfectly free up to the path, and diseased on the other side, about 4 feet.

Mr. WORTHINGTON G. SMITH, F.L.S., called in; and Examined.

Mr. *Smith,* F.L.S.

Chairman.

2088. YOU have taken a great interest in the potato disease?—A very great interest.

2089. You were the first, I think, to draw the public attention to the question of rest spores?—Yes, I was the first to complete the life history of both the *Peronospora* and the *Fusisporium*. I discovered the resting spores of both.

2090. That, I think, is thoroughly acknowledged by the Botanical Department of the British Museum?—I have not been informed to the contrary. I have brought a drawing of the potato fungi, and as it is very difficult to give a complete idea of the extreme minuteness of them, I have also brought a drawing of the green fly, a very common insect on the potato plant, and drawn to the same scale as the fungi.

Mr. *Macdonald.*

2091. Is that a copy of what was produced by Mr. Dyer?—No, it is an original drawing made by myself. For the sake of analogy (exhibiting a drawing) this is a drawing of a green fly to the same scale as these fungi, and you will see from the size of the fly that it is almost impossible to conceive of the minuteness of the fungi. This green fly is so large in comparison with the fungus that thousands of the spores could go inside the body of it. It is not very infrequent to find the spores in the antennæ, legs and body, of this animal. The two drawings together give a very good idea of the minuteness of the fungi. I have also brought photographs of the resting spores. They are very difficult to take, because the potato is an opaque object, and it is most difficult to get light into the microscope. The spherical bodies are the resting spores.

Chairman.

2092. Are these streaks what are called the mycelium?—Yes, the spawn, or mycelial threads. They correspond with the streaks seen in the photograph.

2093. Are these photographs from nature?—Yes. I have also a microscopic slide set in order here, with the same resting spores visible.

2094. Could you give us some general statement about this matter?—I have carefully written out a statement if you will allow me to read it. I attended to your questions with great attention during the examination on Friday last, and I think I have got the answers in tolerable sequence. The nature of the fungus first in order of the potato disease, *Peronospora infestans*, a fungus which invariably accompanies the murrain, has probably been fully described to the present Committee; first by Mr. Dyer, of Kew, and next by Mr. Carruthers, of the British Museum; so that it is unnecessary for me to refer to it again in detail. A fact unaccountably lost sight of by many botanists is, that there is a second fungus parasitic upon the potato plant, second in order with the *Peronospora*, and almost equally virulent with it. This second fungus is named *Fusisporium solani*; it commonly grows in company with the first upon potatoes. Like the first, too, it disorganises by contact, and it is almost, if not quite, as powerful in causing the utter destruction of the potato crop as the *Peronospora* itself. Both these fungi go to rest in an egg condition; the eggs, or "resting spores," as they have been termed, of *Peronospora*, are capable of remaining in a hybernating state in the ground for a period of from one to three years before they show any signs of renewed life;

Chairman—continued.

life; whilst the resting spores of the *Fusisporium* seldom hybernate for a period larger than from three months to one year. It is a very easy matter to destroy the fruiting branches of both fungi whilst in a growing state, but the resting spores are able to resist climatic extremes of moisture, dryness, frost, and heat. The resting spores of both these fungi continue to hybernate whilst climatic conditions remain unfavourable to their active growth; but on the advent of a favourable amount of humidity and warmth they start into renewed life, and in the first instance grow on any material at hand provided it is not caustic or corrosive. Microscopic fungi are commonly prepared for prolonged examination in glycerine, and nothing is more common than to see the spores of the potato fungus (and the spores belonging to many other fungi) growing in glycerine. The sudden onslaught then of the potato-murrain each successive autumn is caused by the advent of exactly sufficient warmth and humidity to suit the germination of the resting spores. The resting spores or eggs of both the *Peronospora* and the *Fusisporium* rest on and in the ground everywhere, especially in damp places and amongst decaying vegetable refuse. When these eggs at length burst they generally protrude threads which carry seeds or spores, and these seeds are set free in uncountable millions. These seeds sail through the air, and such as fall upon potato plants rapidly gain an entrance to the interior tissues of the host and cause its corrosion and destruction. No doubt living resting spores together with fungus spawn are often planted with potatoes, and when this is the case, the disease commences with the tuber and works upwards, whilst in the former case, *i.e.*, when the germination of the resting spores takes place upon the neighbouring ground, the leaves are the first parts attacked from the air, and the disease works downwards to the tuber. Diseased potatoes when planted often produce perfectly sound crops, for it by no means follows as a rule that because a potato is merely discoloured and 'diseased' as potato growers say, that it must invariably carry within itself healthy hybernating spawn or hybernating spores, or seeds of the murrain capable of reproducing the disease. When potatoes once have the murrain decidedly upon them, cure is perfectly hopeless; the potato plant is permeated by a poison hostile to and potent against its life, and no treatment can possibly renew the corroded and putrescent tissues of the potato plant. The position of the potato in a case like this is equally hopeless with that of a human subject under the last stage of blood poisoning or consumption. The above being my opinion of the hopelessness of cure, I will concisely confine my remarks to the answering of two main questions, viz.: 1st. Why does the potato plant fall such an easy prey to the murrain? 2nd. Is it possible to prevent or palliate the destructive virulence of each annual assault of the fungus? Why does the potato plant fall such an easy prey to the murrain? My answer to this is, that although there are many well-known instances of bad attacks of the murrain falling upon well-cultivated crops, yet as a rule (and taking an average of the general mode of culture throughout the country) potatoes are badly stored, badly planted, badly cared for, and, as a rule, carelessly and ignorantly thrown out of health. It must not be forgotten that the potato is not a hardy plant with us; it leads a somewhat unnatural life under adverse conditions, and it requires nursing. When potatoes are stored, they require, as conditions of the first importance, both dryness and coolness, whilst, as a rule, potato growers subject their potatoes to moisture and over-heating. Stored potatoes are commonly piled in heaps during the entire winter, and in these death-heaps the potatoes get bruised, heated, and thrown completely out of condition. Stored potatoes are commonly in a hotbed of disease. The potato tuber, thus fermented and damaged, is now commonly cut into pieces, and the pieces, whilst still wet, are too frequently placed in the furrows of the ground in actual contact with rank dung and refuse, this material being saturated with spores and vermin of all sorts. The potato has, by this time, more or less lost its constitution, and the position in which it is planted too often adds to its troubles, for when potatoes are grown in marshy places and on flat alluvial plains, they require a different mode of culture from the same plants as grown in dry calcareous earth. As a rule, too, potato growers crowd their plants too much together, and the potatoes are in as bad a plight for contracting disease as human beings and other animals are, when constantly kept in over-crowded, ill-ventilated places. The murrain of potatoes is not confined to the potato plant, for it attacks with equal virulence (especially has this been the case during recent years) the tomato. This latter plant, like the potato, requires special care in cultivation; and where this care is not forthcoming, the whole crop is utterly lost. The murrain also attacks various wild plants in this country (principally members of the family to which the potato belongs); but these plants being healthy, hardy, and natural to the soil and climate, throw off the murrain with ease, and rarely succumb. Records of facts of this class could be multiplied to an almost indefinite extent; hardy native and uncared for subjects escape, whilst introduced subjects fall. For instance, there is a well-known disease of houseleeks named *Endophyllum sempervivi*. This is of the rarest possible occurrence on the hardy common houseleek of our roofs and gardens; but when the disease once gets amongst exotic species of *Sempervivium*, it completely destroys every plant. It is the same with the hollyhock disease, *Puccinea malvacearum*. The old hardy single hollyhocks of cottage gardens throw off the disease with ease, whilst the tender, highly-cultivated garden varieties are utterly destroyed. Peaches, when grown on walls and exposed places, fall a prey to a disease named *Ascomyces deformans*, a disease almost unknown amongst peaches when carefully grown in fruit houses. Late fruiting garden peas are often completely destroyed by a fungus named *Erysiphe martii*, but this fungus has very slight effect on the hardy wild peas. The following observations belong to a similar class of facts. A race-horse may be as healthy as a waggon-horse, and may be able to live as long a life; and a well-tended spaniel as healthy as a Scottish shepherd dog; but one must be cared for in a different style from the other if life and health are to be equally satisfactory in both. I conclude, therefore, that the potato plant would not

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not fall such an easy prey to the murrain if it received greater care in its general storage, planting, and cultivation. It now too often falls a prey to the infectious murrain in the same way as the unclean and improperly fed human beings of populous districts fall before certain diseases, whilst clean, well fed, and healthy individuals escape. Healthy, or apparently healthy, potato plants may occasionally succumb to the murrain in the same way as a doctor may occasionally die from fever communicated by a hospital patient. The second and last question, "Is it possible to prevent the destructive virulence of each annual assault of the fungus"? is far more difficult of satisfactory answer. I, however, most certainly consider a great reduction of the amount of disease to be quite possible. The attacks cannot be mitigated by cure, but a strong attempt might be made towards the prevention of the murrain. With a correct knowledge of the nature and cause, nearly every known disease can be prevented or palliated, especially when there is a specific poison in the case as with the potato disease. As for stamping out the murrain, or isolating cultural experiments to an island in the sea, a short distance from the shore, any such attempt would be utterly futile. Spores are present everywhere, and can no doubt be carried through the air across a sea or ocean, as readily as over a hedge. Spores everywhere sail with the wind, and at the same speed. Nothing is better known than the descent of spores, pollen, and other minute organisms on to ships in mid-ocean. If potatoes were taken into an island in the middle of the South Pacific, or transported upwards for miles into the air, or submerged for years in a river, they would yet be liable to contamination from the *Peronospora*, for the spores of the fungus are everywhere. The resting spores have been kept alive for three years simply in pure water, and they germinated after this time. In fact, the only way to satisfactorily see the ordinary spores germinate is in water. I have for many years been in the habit of constantly using the microscope, and I have found the spores of the potato fungus on the most diverse objects, and from the most diverse positions, showing that the spores must have been blown for long distances in every direction. Now suppose the statement to be correct (although it is not correct) that the spores of the potato fungus are not carried far by the wind, are there no other means of dissemination at hand than disturbed air? Suppose a fox or hare runs through a field of infected plants, and then goes off to non-infected districts, he will carry tens of thousands of spores in his coat. Suppose a bird alights amongst infected potatoes, when that bird flies off he will carry tens of thousands of spores in his wings, and discharge them into the air as he sails over the country or the sea. The innumerable beetles, flies, moths, butterflies, and grubs found amongst potato plants commonly swarm with spores. When a farmer goes into his infected fields he inhales the spores into his lungs, and when he eats his fruit from the walls of his kitchen garden, he takes the spores into his stomach. From the above it will be clearly seen that any idea whatever founded on stamping out, can only be a wild dream. Prevention is the only means worthy of a moment's consideration. In my opinion a careful selection of tubers is

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first required. Many varieties of potato are known to be less liable to disease than others, and these varieties might be authoritatively recommended for cultivation, especially in those districts where the conditions for the spread of the potato disease are favourable, as in the low terraces and plains belonging to rivers and in humid districts. The fact that some varieties of potato are highly susceptible to disease will not admit of doubt, and such varieties should be confined for culture to greenhouses and calcareous or other suitable soils. We have facts of a similar class in the human family; for instance, some persons are constitutionally highly subject to zymotic diseases, as typhoid and diptheria; other persons cannot go near a hay-field without contracting hay-fever. In opposition to being highly subject to special diseases, certain other individuals, both animals and plants, are equally able to throw them off. In a paper read by me before the Scientific Committee of the Royal Horticultural Society, I detailed some experiments in which I inoculated, by actual grafting, the tubers of diseased potatoes into those of sound ones; in some instances a thick slice of a highly diseased potato was spliced into the substance of a sound one; the constitution of the host potato was, however, in some instances, so robust, that the host grew well, and with no effects of disease in its after-growth. I have also carried out similar experiments with the fungus of the hollyhock disease, and other plant diseases, and always with like results, viz., that infection was something simply impossible with sturdy plants. These facts also find a parallel in the human family, in the application of vaccine from the cow. In some individuals vaccination is entirely without effect as regards the production of cow pox. It may therefore be regarded as a certain fact that robust, early ripening varieties of potatoes might be selected for general cultivation with advantage. In the next place, it might be recommended that all potato tubers should be preserved through the winter in a perfectly dry place, and dusted with some caustic material. Thirdly, the cut tubers should never be placed in the furrows till the cut surfaces of the potato have healed, and never, under any circumstances, should they be placed directly on to farm yard manure, or over-crowded, as they commonly are, in the furrows. Fourthly, special cultural directions might be printed for the proper growth of potatoes on peaty, sandy, loamy, calcareous and other soils Lastly, all potato refuse should be completely burnt every autumn, and never, under any circumstances whatever ploughed in. If directions like these were scrupulously attended to, my belief is that the potato plant would in a few years be able to throw off attacks of the disease as easily as now does the wild plant of our hedges, the common bittersweet, *Solarium dulcumara*. A piece of ground (the number of acres to be afterwards decided upon) might be selected as an experimental garden, and a responsible director appointed. This piece of ground should be situated on an elevated, exposed plateau on a thirsty calcareous soil. Many such positions are to be seen in Bedfordshire and elsewhere where the chalk comes to the surface. The gardens at Kew and Chiswick are entirely unsuited to the purpose. All farm-yard manure should be discarded, and chemical manures only used. Varieties of the potato known as early ripeners

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peners and potatoes with the strongest constitutions only should be grown. Late ripening in a potato is a fatal defect in the hardiest plant, for all experience shows that sooner or later a late ripener is certain to succumb before the murrain. These early and hardy potatoes should be continually crossed and recrossed, so that by constant selection and improvement the production of hardy new varities might be secured in succession. Such new forms as these grown in a favourable geological position, and under the best cultural conditions could hardly fail to be the precursors of hardy new races. On the experimental garden, a store shed should be built capable of preserving the potatoes in perfect dryness during the winter, and the seed tubers should be preserved in a slightly cautic material. All apple growers know that unless they keep their apples perfectly dry during the winter every fruit will be destroyed by a fungus named *Oidium frunctigenium*. Now, stored potatoes are equally valuable with apples, and they demand and deserve equal care. In a garden such as here described, many sturdy varieties would without doubt soon be produced: these varieties would have a considerable market value, and an experiment of the nature indicated could probably be made to pay its own expenses. But although rules like these may be useful, the great and difficult question is, how can such rules be made everywhere known in Great Britain? How can all potato growers be made to understand and appreciate the probable benefit belonging to a careful adherence to a certain strict code of regulations? Not one potato grower in a hundred knows anything about the exact nature of the potato murrain, the majority of farmers do not know whether the disease is an insect, a fungus, or a gas; whether it is caused by a fog, rain, or a thunderstorm; what it is, whence it comes, or where it goes, they have no idea. It is a small minority only of potato growers who buy agricultural, horticultural, and farming newspapers. A comparatively few only are members of our great Agricultural Societies, and potato growers may be said, as a rule, to know little or nothing more of the potato and the murrain than that they every year see and propagate both. My suggestion then might be as follows:—In the first place, a notice might be printed and sent to all the post offices and police stations in the kingdom, the notices to be exhibited in some public manner, so that they might be seen by all persons. The notice might be to the effect that a strong attempt was about to be made towards the mitigation of the potato murrain, and that any person who had a certain number of acres of potatoes under cultivation, and who wished to possibly secure himself against the usual annual loss, might obtain information of the means proposed to be taken at the nearest post office or police station. On applying at the office or station, each applicant might be furnished with a paper, to be filled up with a statement of the number of acres under cultivation, the usual mode of culture, storing, &c., the variety usually grown, with other particulars as to soil, &c., which it is unnecessary for me here to write out in detail. This paper should be posted on to some society, office, persons, or person in London or elsewhere, for consideration; suitable replies should then be ready for posting back to the applicants, and, in some instances, personal advice or inspection of a district and its surroundings might be given if desirable; but always on condition that the recipient of such advice, printed or personal, not only promised to act upon the advice given, but also agreed to fill up another printed form of results, for comparison with the results received from other sources at the end of the season. The results and experiences thus obtained from different quarters of Great Britain, as to the varieties of potatoes grown, the modes of storing, general culture, average losses, and other particulars, should then be carefully tabulated by the society, person or persons above mentioned. These persons should be well acquainted with potatoes in their different varieties, their constitution and culture, and well acquainted with the exact nature of the murrain by which potatoes are now so badly afflicted. Results thus obtained would probably form a good foundation for a complete knowledge of the exact requirements of the potato plant under the different climatic and geological conditions peculiar to Great Britain. I am not much in favour of subjects of this class being relegated to societies and academies. It too often happens that bodies of this class effectually smother a subject with a maximum of words and a minimum of work. Provided a competent person could be found, I am in favour of the appointment of one absolute responsible ruler and master; a person who should be allowed to take the entire subject of the potato murrain in hand for a series of years on his own responsibility. If such a person could be found, any number of suggestions or facts might be submitted for consideration or tabulation, but provided the responsible leader of the investigation had the requisite knowledge and experience, he should be allowed to work out his own ideas in his own manner. I have now sketched out, as I see them, the broad outlines of the practical side of this great and important subject. I have purposely refrained from entering into minute botanical details; most of these details are now undisputed and known to all competent botanists. I have also purposely refrained from entering into cultural, chemical, climatic, and geological details and statistical details of all sorts, and have purposely adverted to no potato or potato raiser by name. The salient outlines of the subject are first wanted, and if these outlines as now indicated by me are accepted, all the details with which such outlines must at length be filled, will be forthcoming.

2095. Have you any particular reason for calling it murrain?—No, murrain means a bad, infectious, and fatal disease generally; often a blood poisoning disease amongst animals.

2096. You take it as indicating the same as blood poisoning in animals?—Yes.

2097. Did you say at the beginning of that valuable paper, that there were two kinds of fungi?—Yes, two distinct fungi; *Peronospora infestans* and *Fusisporium solani*. The latter is called *Fusisporium*, because the spores are spindle shaped, they are fisiform; the two fungi are perfectly distinct, but they grow together.

2098. Are they different in appearance?—Somewhat different in appearance. They are drawn on that sketch. Here is a sketch of the *Peronospora*, and this is the *Fusisporium*.

2099. Have they ever been confounded by some people as being one fungus?—No, they have never been confounded.

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2100 Is the *Peronospora infestans* much more numerous and much more important than the other?—Not much more. I think the *Fusisporium* has been carelessly overlooked.

2101. Do you ever get one without the other? —Sometimes.

2102. But practically?—Practically not.

2103. You said there was a difference in the mode of propagation of the two, or of the time the spores remained. Will you tell us what the difference is between the two?—They are different fungi, and no doubt Mr. Dyer and Mr. Carruthers have fully described the *Peronospora*. The *Fusisporium* forms a dense mass of transparent threads on the leaves and tubers of the potato plant. One commonly sees it like a cornfield with tens of thousands of threads, and each thread bearing a spore on the top in the shape of a spindle. That spore breaks into four pieces as you will see on this drawing, and each of these four pieces at length forms a resting spore, falls on to the ground, and goes to rest for three months, or sometimes for a year.

2104. Can it rest for more than a year?—I have never known it to rest for more than a year.

2105. The *Peronospora* can rest for three years? —Yes, I have kept it in a resting state for three years.

Mr. *Macdonald.*

2106. In glycerine?—No; in water.

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2107. Practically, you say, one is not found without the other?—Practically one is not found without the other; they commonly grow in company with each other.

2108. In considering this question, practical men need hardly take into account the fact of there being two distinct fungi?—No, because any successful treatment of the one would be certain to be successful with the other.

2109. Is there any possibility of the two fungi being really two modifications of the same plant? —No, I think not.

2110. There is no doubt if you have propagated each from its own seed?—Yes. I have grown each from its own resting spores many times.

2111. There is no suggestion as to there being two sexes?—No, you get the two sexes in the *Peronospora*. These (*referring to a drawing*) are bladders formed on the threads of the mycelium, and the larger bladders are the female bodies, there are also smaller bladders, and those smaller bladders are male organisms. If two female bodies come in contact you never have any other further result, and if two males touch you never have any further result; but if one of the male bodies comes in contact with the female, the male protrudes a sort of beak into the side of the female organism, and the contents of the male are poured into the body of the female; the male then perishes and drops away, and the beak is left in the body of the female. The resting spore matures itself and goes to rest for three months in the *Fusisporium*, or possibly for three years or more in the *Peronospora*. These observations have been repeatedly confirmed. I have not the slightest doubt about the correctness of them, because the phenomena are not peculiar to the fungus of the potato plant, but they apply equally to many other allied fungi. The phenomenon is perfectly well known.

2112. There was a difference of opinion between some of our scientific witnesses, Mr. Dyer on the one hand, and Mr. Carruthers and Professor Baldwin on the other, as to whether this disease was in the country before 1844; what do you believe on that subject?—I decidedly believe it was here a long time before 1844.

2113. And that it only developed itself?—And that it gradually developed itself with the cultivation of the potato plant.

2114. In 1844?—Yes, but we have records of it being present long before then.

2115. Could there be any possibility that one of these fungi could have been here before, and another one have come in 1844; could you attempt to reconcile the discrepancy in the evidence in that way?—The facts are well known that both the fungi of the potato disease were in Europe before 1844.

2116. And to any considerable extent?—The facts are not fully known in detail; we have reports of them from different parts of Europe.

2117. Could you tell us anything more fully upon that subject, or could you tell us anything to show that it was in Europe before 1844 and 1845?—In the proceedings of the Royal Horticultural Society and elsewhere there are long statements of the dates of the different appearances of these fungi, but I cannot remember all the dates or the places.

2118. Your opinion is that it was here before? —Yes, most decidedly.

2119. How do you account for that tremendous outbreak which took place in 1846 if it was an old disease?—It is difficult to account for such a phenomenon; the disease possibly existed in a bad state, but did not get recorded till it was very bad indeed. Epidemics are known to be subject to sudden acceleration.

2120. Now about the resting spores, do you think the resting spores are the principal mode of propagation of the disease?—It must be almost the only mode of propagating the disease from year to year.

2121. Do not a good many scientific men say that the mycelium, the body of the plant, carries the disease over as a rule from one year to the other; there is a difference of opinion in that, I think?—There is not a very decided difference of opinion; the mycelium is known to be capable of hybernation, and possibly under favourable circumstances the mycelium may live through the year, but I should say not as a rule. Hibernating spawn of the potato fungus is one of the rarest objects known to botanists. It has only been seen by a few observers, and on rare occasions. Of course the mycelium of the common mushroom hybernates in a very similar way; it rests in the "bricks," as they are termed, of the mushroom-spawn dealers.

2122. Then you think the mycelium has very little practical effect in carrying it over?—No, I think it is virtually preserved from year to year by the resting spores.

2123. Do the resting spores adhere chiefly to the potato, or remain in the soil, or remain with the stalks?—They are extensively found in the old exhausted seed potatoes in the autumn, at the time of lifting.

2124. Inside

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2124. Inside them, or clinging to the surface?—They are inside.

2125. Then it is impossible to get rid of them by any operation without killing the potato?—The seed tuber is an exhausted tuber, from which the potato plant has been grown; it is already dead in itself, but it swarms with living germs of the potato fungus. No doubt the old seed tubers should be burnt.

2126. Is it only in those potatoes which appear diseased and which we can detect as diseased, or do the resting spores remain in some potatoes which are impossible to detect from really healthy potatoes?—I do not think the resting spores as a rule are present in potato tubers at all when planted; they are generally present in the old potato refuse of the previous year, the refuse that is thrown on the dunghill in the autumn. It is very common to find the resting spores in the dunghill; I have often taken them from such positions, and found them in the juice which exudes from the dunghill, when potato refuse has been incorporated with the dung.

2127. I suppose you agree that the general propagation of the disease, once the summer has come, is by an infinite number of ordinary spores which remain over the winter. Do you agree in that view taken by the other witnesses as to the production in July or August of the disease?—The explanation of the appearance of the disease in July is, that the resting spores which have hybernated in the ground, or in dunghills, or on vegetable refuse, or at ditch sides, grow in those positions on the ground, throw up threads, and set free spores of a different nature from the nature of resting spores. The simple spores, borne on the threads, now sail through the air.

2128. What do you call those spores; ordinary spores?—They are commonly called conidia, or dust-like spores.

2129. Do you agree with Mr. Dyer and Mr. Carruthers as to the immense number of these conidia?—Yes, they are innumerable.

2130. And that is the manner in which the disease spreads, from a few plants to a great mass of plants?—Yes, provided the mass is in a fitting state to fall an easy prey to the spores thrown off from a few.

2131. Is there any great object in a practical farmer getting rid in his seed potatoes, and in his dunghill of the materials for propagating the disease, if another man within half-a-mile plants diseased potatoes from which afterwards sail into his field?—I do not believe that perfectly healthy plants will take the disease as a rule.

2132. You have said that the spores will grow on any material which is at hand, as well as on the potato?—Yes, provided it is not caustic, dry, or burning.

2133. Will it propagate itself on other matters?—Yes, it will make a beginning, so as to set free the first spores in the air.

2134. Would it grow on the wood or leaves of an ordinary plantation, and send out fresh spores to seek the potato plant?—Yes; the resting spores will grow in any possible position and develope fresh spores, provided there is proper warmth and moisture; the resting spores give rise to the secondary spores.

2135. In any considerable numbers?—Yes; large numbers.

2136. Have you tried that experiment?—Yes, I have constantly repeated experiments and observations of this nature.

2137. Have you seen them grow on such things as woods and trees?—It is perfectly well known that the resting spores will remain alive and grow on wood, paper, rags, vegetable and animal refuse, and in fact on the most diverse materials.

2138. We have not had that fact, I think, from any other witness?—Many such facts have been published by different botanists.

Sir *Edmund Filmer*.

2139. They will live anywhere?—They will germinate on any material provided there is sufficient moisture and warmth, and in this primary position produce the first spores of the plant.

Mr. *Storer*.

2140. That accounts for its appearing in wet summers, I presume?—Yes. With the advent of the rains of early autumn, these resting spores burst on the ground. They first of all grow on the ground, or in, or on, refuse.

Chairman.

2141. If potatoes are planted each second year in the same field, would you expect that the action of the resting spores which remain in the ground would be very serious?—Yes.

2142. If potatoes were only planted every fifth or sixth year, you would not expect such an effect from the resting spores in the ground?—No, I should think the resting spores would perish in five or six years.

2143. You think they would perish in three years, do you?—I should think after three years. It is a very wonderful fact that they can live for three years, but I know it to be a fact.

2144. Then, you think if people planted potatoes every second year in the same field, they would be more liable to take diseases than if they waited a longer time?—Yes.

2145. There would be a great difference in the per-centage of disease?—Yes.

2146. I do not know whether you are aware that that is a common habit in a large portion of Ireland?—Yes.

2147. You have no doubt spores sail in the air?—Not the slightest doubt.

2148. And, in fact, that the disease is propagated by means of the atmosphere and the wind?—Yes; I have not the slightest doubt of it.

2149. And you think they sail many miles?—Yes, any number of miles; wherever the wind goes, there also the spores are carried.

2150. When the disease is propagated from one plant to the other, during the summer, the disease invariably commences with the leaves, does it not?—Yes.

2151. But if it is sown with the seeds, or if it remains in the soil, it commences with the tubers?—Yes.

2152. Do you think the ordinary potato pit a bad way of keeping potatoes in the open air?—Yes, very bad indeed; the worst possible way.

2153. You do not think the coldness of the open air piles in the field make up in any way for the superior ventilation of the loft?—No, but potatoes are frequently preserved from the cold in the fields; it is very common to see them preserved from the frosts.

2154. They put straw on them to keep away the

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the frost; you are in favour of this; that seed potatoes should be kept in some dry and cool place?—Yes.

2155. Do you think the stalks ought to be burnt each year?—Yes, certainly.

2156. Do you think that is an important matter?—A most important matter. The old decaying stalks are commonly full of resting spores.

2157. Do you think it would increase the percentage of sound potatoes in the district, if there was a law that the stalks should be burnt by some local authority?—Certainly, I do; the stalks and potato refuse are the chief propagators of the disease.

2158. Do you think it would be worth legislation on the subject?—Yes.

Sir *Edmund Filmer.*

2159. And diseased potatoes too?—Yes.

Chairman.

2160. Are you aware that diseased potatoes in Ireland are generally given to cattle or pigs?—I have heard so.

2161. Does any bad effect follow from that?—No worse effect than ploughing in the potatoes, I should say.

2162. Is there a worse effect than burning the potatoes?—Burning potato refuse of all sorts is of the highest importance.

2163. But are not these potatoes generally boiled before they are given to the animals?—Not invariably.

2164. If they were boiled, could the disease be carried over than?—No; boiling would certainly destroy all trace of the disease, the same as fire would.

2165. So that you think it would be a bad plan to give the potatoes raw to cattle or pigs; that the disease might be carried over through the intestines of animals?—Yes.

2166. But if the potatoes were boiled first?—That would certainly destroy every germ of the fungus.

2167. Then you think that something depends on the way in which potatoes are cut, and the way in which they are put in contact with suitable manure?—I have always thought so.

2168. Would dipping them in lime and water be of any use?—Dry quick lime in powder is the best material, but I think I should advise scorching on a surface of heated iron.

2169. You said there was a difference in the way potatoes should be planted and treated in wet places and in dry; what difference would you make between planting in the two kinds of soil; you did not dwell much upon that subject?—I purposely omitted dwelling on that subject, because it is so intricate and complicated in all its details. I should have to go thoroughly into manures, the geological nature of the soil, and the climatic conditions.

2170. Supposing you have wet land that has been drained and cannot be drained any more, or is not likely to be drained any more, what additional precaution would you take with regard to that wet land?—I should not like to answer without proper consideration such a difficult question. I should not choose such land for growing potatoes, but it is by no means impossible, with proper deep trenching and drainage, to make otherwise unsuitable land fit for growing potatoes.

2171. There are a great many spots in Ireland where they cannot get any dry land; have you any special recommendation you would give as to those?—I might, on further consideration, write out recommendations. With deep furrows and high ridges potatoes might in most places be kept from a superabundance of wet.

2172. You say this potato disease attacks other plants. It attacks a small per-centage of them, the tomato?—Yes.

2173. That you think is because those plants are growing in a more natural manner, and are hardier?—Yes.

2174. And consequently, if we get a hardier kind of potato, it will resist in the same way?—Quite so.

2175. I do not think you dwelt on the question as to whether the potato being a long while away from the seed, under the ordinary system of cultivation, becomes more delicate and less capable of resisting disease, the potato being propagated year by year through the tubers, and not from seed from the potato flower. Have you thought of that question?—Yes, I have thought of that question a great deal.

2176. What are your views on that subject?—My impression is that the potato plants would be better if produced from the seeds from the berries, not invariably from the tuber or cut tubers.

2177. Do you think that, being 20 or 30 years away from the seed, and being propagated 20 or 30 years from tubers, distinctly deteriorates the plant in its power of resisting the disease?—Yes, that is my impression.

2178. Consequently, you deduce from that, that we ought to have fresh varieties every 20 or 30 years?—Yes, frequent seedling varieties.

2179. After what period do you think a variety of potato gets more delicate?—I have not had sufficient experience to answer that question. There are so many varieties of potatoes that it would be difficult to answer such a question so as to make an answer apply to all alike. One wants to know the particular variety of potato and the circumstances under which it has been grown. Potatoes are very different from each other in their constitutions. A potato grower would best be able to answer the question.

2180. You dwelt a good deal upon having early potatoes; is that to escape the rains at the end of July or the beginning of August?—No, not to escape the rains, but to escape the spores of the fungus, because the spores of the fungus are seldom seen till July.

2181. Why are the spores of the fungus seldom seen; would not they get earlier with earlier potatoes, or does the weather make them develope?—It appears to be the weather. There is a certain law of nature, that these spores are to sleep for a certain number of months, and they invariably wake up at the end of a certain number of months, just the same as birds, flowers, and insects return at a particular time.

2182. Would there be any danger if the potatoes were got earlier that the disease would get earlier too?—No, I think not. I have thought over that subject, and it is difficult to say, but I should think not at present, though it is possible that

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that the parasite might change its nature with the new plant.

2183. It would be a great point, then, to get your potatoes at what date?—July.

2184. What part of July?—That would vary somewhat for different parts of the British Islands. I should say the month of July would be sufficient.

2185. You think it is possible?—It is quite possible, I think. Some potato growers are always without disease, because they only grow early potatoes.

2186. You dwell a good deal on having early potatoes, for that reason?—Because early potatoes seldom have the disease; they are harvested before the disease appears.

2187. There was one potato grower who said it was a good thing to change seeds from high lands to low lands, and gave as a reason that the potatoes did not ripen in the high land, and it was rather better bringing them down the next year for seed to the low land?—I should think such a procedure likely to be beneficial.

2188. What should you say would be the scientific reason for that?—That the potatoes found in the new position what they could not secure in the old.

2189. Then you think it would be well to bring potatoes that had not ripened thoroughly in high lands to better lands?—Yes, decidedly.

2190. You have given us an idea about the way in which you think the Government might beneficially interfere in the growth of potatoes?—Yes, I have roughly sketched out a plan.

2191. Would your idea be that they should take a single farm, or that they should take land for two or three farms in different parts of the country?—I think a single farm would be better.

2192. Would you see a danger of disease getting into the ground on that particular farm if they grew nothing but potatoes?—I believe not. I have found many farms on calcareous, and sometimes sandy soils, where the potatoes have been remarkably free, as a rule, from the *Peronospora*. The *Peronospora* sometimes avoids clay districts.

2193. Do you think that would be a better plan than offering prizes for new kinds of seed?—New kinds of seed would have to be tested before one could become aware of their merits or demerits.

2194. You have told us nothing about the different existing varieties. You did not like to name any particular variety, but the Committee would like to know your opinion on the present varieties; do you think the Champion a very excellent variety of potato?—It is said to be very good, but unfortunately it is one of the late ripeners.

2195. And that would be your only objection to it?—Yes; but a strong objection.

2196. As a general rule, are the late ripeners more hardy than the earlier ripeners?—No.

2197. The two things are not impossible; getting a hardy potato and an early potato?—No.

2198. Otherwise you think the Champion to be a good potato?—Yes.

2199. Are there any other varieties which are really healthy and strong, as far as your observation goes?—Yes; I have noticed two specially.

2200. Will you give us their names?—One is Sutton's Red Skin Flour Ball, although that is not always entirely free from disease. The best potato I know is Patterson's Victoria. I have experimented a great deal with different varieties of potatoes, and that one has always come out best with me.

Mr. *Arthur Moore.*

2201. Are those early potatoes?—No, but the later pototoes can be forced forward by early planting and manipulation.

Chairman.

2202. You have also said that on these experimental farms nothing but chemical manure should be used. Would that be to avoid propagating the disease through farmyard manure?—Yes.;

2203. Do you believe much in the addition of potash for potatoes?—Sulphate of potass is a very essential ingredient as a manure for patotoes; it gives some of the best results.

2204. Is it insufficiently supplied in some districts, such as Ireland?—Yes.

2205. There is not nearly enough potash?—That is the statement of agricultural chemists.

2206. Is that your own belief?—Yes; I am guided by them.

2207. There is no other chemical ingredient that is not supplied in sufficient quantities, is there?—The soils of Ireland must differ in their constitution.

2208. Would you say that there was a notable deficiency in the supply of potash as a manure in some districts, such as Ireland?—Certainly.

2209. And that there is no notable deficiency in the supply of any other necessary ingredient?—I have not sufficient data for a reply that should include the whole of Ireland.

Mr. *Macdonald.*

2210. You stated your belief that the disease had been long in the country before 1845?—Yes.

2211. Have you any knowledge, or do you state that from experiments you have made since?—No; there are many published statements in books and papers long before that date of the presence of the disease in this country and in other parts of Europe.

2212. I am quite aware that there were diseased potatoes, but that was the disease of the same description and character as the present disease, which you have so clearly pointed out is the result of the two fungi?—Probably scientific men in those times did not work with the microscope as much as they do now, but everything points in the direction, that it really was the same disease then that we have now.

2213. We have had it stated here that the original potato is a native of Peru. Have you any idea as to whether that is correct?—Yes, that is correct.

2214. So that, though you differ with those who state it is a native of Peru, in point of time you do not differ with them as to that being its original place?—No; I do not differ at all. The potato plant is a native of Peru, and most likely the fungus is a native of Peru as well.

2215. That is exactly what I was going to ask. If the pototo plant is a native of Peru, is it very likely to have sprung from that very soil?—Yes; I think so.

2216. We have had it stated that it came with guano?

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guano?—Yes, I have often heard that opinion mooted.

2217. Do you favour that opinion?—I cannot say that I have a decided opinion on that subject. I have often seen the statement in print, and it seems to me that it may possibly be true, but I have no direct evidence of it.

2218. There is no reason why it should not be the fact?—No; it is quite possible, I believe, as the guano came from the home of the potato plant, and it is a material suitable for the preservation of resting-spores.

2219. Then the Chairman asked you why it was that, if already here, it appeared most violently in 1845 or 1846; may it have been that the season in 1846 was peculiarly adapted for the development of the disease?—Yes, that is most likely to be a correct explanation of the phenomenon.

2220. Now, I take it from your answers, that you are not desirous of continuing much longer in dependence on private experiments, but you would rather see this matter taken up in some substantial way by the Government?—Yes, I think it is desirable.

2221. Considering as we have had it stated, that it was a loss to Ireland last year of 8,000,000 *l.* of money, do you not think that it is highly desirable that this should be done?—Certainly; the potato disease is now a very serious national loss to the country, and its combating is quite beyond private enterprise, in my opinion.

2222. Then if we had farms of the description that you indicate, would you think that we could acquire more knowledge of the enemy of the potato, or the murrain as you have termed it, than we have now?—Yes, decidedly.

2223. You do not think our knowledge is yet complete in that respect?—Our knowledge is complete of the nature of the potato fungus and of the murrain, but our knowledge is insufficient of the different varieties of the potato and their capability of resisting disease; we are also very badly in want of cultural results.

2224. I take it from your answer, there are soils and conditions of soil, geological and otherwise, that are better adapted for one class of potato than another?—Yes, certainly.

2225. Would it not be a highly desirable extension of our knowledge, if we were able to point to those districts where a certain class or a certain kind of potato would grow, with almost absolute immunity from disease?—Yes, such facts would be of the highest value.

2226. That is another reason why you think we should have a Government farm, or that it should be under the charge of the Government?—Yes. The facts mentioned should be all gathered together and tabulated carefully.

2227. We have a large quantity of potatoes imported into this country yearly in the early part of the year?—Yes.

2228. Have you turned your attention to the adaptation of soils in any part of the country where we could produce potatoes as early as they are produced on the continent, that is, in Belgium or Holland?—No, I have not.

2229. One witness has stated that he believed there were certain districts in the United Kingdom and the islands adjacent where potatoes could be grown quite as early to go to market as they are in Belgium or Holland, where a great deal of our potatoes have come from?—I have not turned my attention to it. I think such a statement is possibly correct.

2230. Now if this matter were under the care of the Gorvenment, should we not be able to ascertain in a very short time if such were the case?—Yes, if the experiments were taken in hand without delay.

2231. Therefore it would be a very great saving?—Yes, a very great ultimate saving, no doubt, would accrue to the nation.

2232. I might apply that a little further than to the potato plant alone. There are other kinds of crops that come into this country. Would it not be desiarable that such a thing should be done with regard to them?—A very desirable thing, sometimes other kitchen garden crops are lost. Entire crops of late peas for instance are oftentimes entirely destroyed by a passasitic fungus.

2233. You think that, looking at it in these various lights, institutions supported by the Government, away from private enterprise, would be far more likely to develope the subject?—Yes, most decidedly.

2234. Do you not think it seems something like a scandal that we should have been for 35 years with the little knowledge we have of this matter, which is such a serious matter?—Yes, the knowledge is possessed by certain individuals, but it is not widely spread; the known facts should be spread more amongst the people generally.

2235. And it is a knowledge which concerns so much, not merely the health, but the food of the people?—It concerns both, and the general wealth too.

2236. You have given a very good description of placing it under proper care. You would have these farms placed in every possible position, in order that you could ascertain the climatic influence, the geological influence, and all other influences that could be brought to bear if necessary, in order to produce a healthy and vigorous potato?—I did not suggest farms, but one farm only, and the data from diverse soils and climatic conditions to be derived from farmers in all districts. The facts all to be manipulated upon one farm only.

2237. You are of opinion that the facts could be gathered from one farm only?—The facts could be practically tested by the director of one farm.

Mr. *Arthur Moore.*

2238. Do you belong to the British Museum?—No; I am not an officer of the British Museum.

2239. Are you attached to any scientific institution or body?—Not as a paid officer. I am a Fellow of the Linnæan Society, and a member of the Scientific Committee of the Royal Horticultural Society; and a fellow or member of many similar societies.

2240. You said you thought that this question of growing healthy potatoes was one that was beyond private enterprise?—Yes, entirely so

2241. You spoke of the hybridising and producing new varieties?—Yes.

2242. That is what you allude to when you speak of its being beyond private enterprise?—Yes, that is one of the points; cultural experiments are others; the getting together and tabulating diverse data and results are others; the amount

amount of work to be done is large, important, and difficult.

2243. That would be the chief point; that would be beyond private enterprise to experiment thoroughly upon?—Yes, entirely.

2244. Have you ever heard of the potato growing in any country in full health?—Not in any country

2245. You make some reservation?—I have known it in some districts, on some farms, and in isolated places.

2246. Have you ever heard that there is a large portion of India where the potato is free from disease?—No.

2247. Or Canada?—No; I have not heard of such places in either of those countries. I have heard of it being uncommonly bad in Canada.

2248. You said just now, in answer to the honourable Member for Stafford, that whole crops of peas had been lost by disease?—Yes.

2249. Is that a disease similar in its nature to the potato disease?—Not very dissimilar; it attacks late peas at the same time of the year. The early peas escape, while the late peas perish.

2250. You think, in such cases, the disease is propagated by the resting spores?—The blight of peas does not form a resting spore of the same nature with the fungus of the potato disease.

2251. After the development of those resting spores, what is the course the disease takes?—The resting spores fall to the ground and rest for nearly a year, and after the lapse of this time the spore bursts and throws out a thread of spawn upon the ground; that thread carries spores of a different nature, named conidia, and these are very light indeed. They are at first borne on the threads, and the first breeze carries the spores off through the air; such as alight on potato plants infect them at once, especially if the plant is in ill health or out of condition.

2252. What connection have those resting spores with the flocculence, the substance found under the leaf of the potato?—The flocculence is really the fungus of the potato disease proper in its usual condition. The fungus threads form the flocculence. This is a drawing of a very minute portion of a leaf. This flocculence emerges from the organs of respiration belonging to the leaves.

2253. After the alighting of one of these spores on it?—Yes; after the alighting of a spore on the leaf, unless the leaf has been infected from below upwards from the tuber.

2254. This flocculence proceeds to grow over the leaf?—Yes; it grows within the substance of the leaf, and throws out these threads. You see here is a hair of the potato leaf, showing how extremely small the flocculence is in comparison with the hair.

2255. Did you ever hear that when old pasture is broken for the first time, no matter how much disease may rage in the neighbourhood, there is comparative immunity amongst the potatoes put into it the first time?—I have not heard of such an instance, but I should think that such a case would be exceedingly probable.

2256. And that would tally with your resting spore theory?—Yes, but it is not a theory; rather a known fact.

2257. You speak of the necessity for destroying the decayed haulms and any portions of potatoes not boiled; would that be sufficient to thoroughly destroy them, or could they be thoroughly destroyed with lime on a dung heap?—I think not. They must be burnt.

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2258. You spoke, too, of the possibility of the spores alighting on the foliage of timber, and disease being so disseminated; are you aware that some years ago there was a great deal of disease amongst the foliage, if that is the proper word, of the larch?—Yes, foliage and timber too.

2259. Has that anything to do with the potato disease?—No; that is another disease. I know it quite well.

2260. What is the origin of that damp?—The origin is unknown; the whole subject of the larch disease requires investigation; a fungus frequently accompanies the disease.

2261. Similar, more or less, in its nature?—Not similar with the potato fungus in structure.

Mr. *Macdonald*.

2262. May I ask upon that this question. Is not the larch at the present moment almost dying out in many districts from that disease?—It is said to be so.

2263. Are you aware it is so?—I have seen a great deal of it in Scotland; my idea is that it is so; I have repeatedly examined the diseased timber and foliage.

2264. In Scotland the larch is disappearing altogether?—Yes, and in the North of England, too.

Mr. *Arthur Moore*.

2265. You believe that it is owing very much to a fungus on the foliage similar in its nature, or at any rate allied to the potato disease?—No, the fungus accompanies, but does not actually cause, the disease.

2266. Then the question comes in, would you recommend as a general rule that the potato should not be too frequently planted in the same soil?—Yes.

2267. And if possible, perhaps, speaking of what is desirable, if convenient, not more than once in four years?—Yes.

2268. And you would also think it very important frequently to change the seed?—Yes.

2269. And also you would think that in many cases it is quite possible there is a lack of potash in land where potatoes have been too often planted?—Yes; it seems to be acknowledged.

2270. Have you a strong opinion as to whether the potato ought to be cut into sets or ought to be planted whole?—No, I have no strong opinion upon that subject. I have made many observations on potatoes planted according to both plans, but I can see no difference myself. The results seem to me to be the same.

2271. Do you believe at all in any electrical condition of the atmosphere having an effect upon the propagation of the disease?—The stormy weather of early autumn favours the disease, because at that time we get the requisite heat and moisture for the propagation of the fungus.

2272. Do you believe it is owing to the heat and moisture?—Heat and moisture aid the growth of the fungus.

2273. In that way it is more noticeable after that kind of weather?—Yes, no doubt.

2274. You think it would be very desirable if possible, to have the potatoes grown as early as possible; I presume that is because the rain and heat are favourable to the development of the resting spores?—Yes.

2275. Have

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2275. Have you ever heard that a green potato, a potato that has been burnt by the sun, is more prolific as a seed potato?—No, I think not.

2276. Is there any brief form in which you could sum up your recommendations?—Nothing different from what I have written down; I have written the statement I have read as concisely as possible.

Mr. *Colman.*

2277. Can you suggest a cheap and easy mode by which the supply of potash is to be obtained?—No, that is somewhat out of my special course of study. Agricultural chemists could recommend that.

2278. You believe it is to be obtained?—Yes.

2279. And if it could be obtained it would be a great remedy?—Yes, I have seen the experiments carried out by Mr. Lawes of Rothhampsted. He grows potatoes under test conditions, using farmyard as well as chemical manures, and sulphate of potass is largely used there.

Mr. *Storer.*

2280. You said something about caustic application; did you mean for the purpose of preserving the seed or the root itself?—I meant it for preserving the cut surface of the seed tuber from contact with manure and infectious matter.

2281. You think that would be a protection?—It would be a very great protection, I am sure. When a potato is bleeding, as it often is when first placed in the furrow, it is very much damaged by the rank manure.

2282. Do you mean quick lime, or something of that sort?—Quick lime would be very good in powder.

2283. You have not had any experience of quick lime as applied to tubers for preserving them for use?—Yes, I have had experience of it.

2284. Do you think that at all a good thing?—Yes, I speak from experience.

Chairman.

2285. Do the manurial effect of burnt stalks and the ashes nearly equal to that of the stalks that are not burnt?—I think that is a question beyond my province. Dr. Voelcker would have answered that better; I should say it is.

2286. Is there much nitrogen in the stalks, because you lose all nitrogen if you burn them?—Yes, nitrogen is an essential constituent of vegetables.

2287. And keep everything else?—Under any circumstances all the potato refuse should be burnt.

2288. Do you think that a man who plants potatoes every second year in a field is distinctly injuring his neighbour as well as himself?—To a certain extent he must be injuring himself, but if his neighbours have perfectly healthy, robust, uncrowded plants, as I said before, I think the healthy plants could resist the disease to a great extent.

2290. Are you able to form any idea why a healthy plant should resist the disease; have you any theory on the subject as to the formation of the plant; is there any difference in the arrangement of the down on the leaf, or can you give any mechanical reason?—No; I think it is impossible to give a mechanical reason; it must depend on the general condition of the plant.

Chairman—continued.

2291. You have not been able to trace it?—No; I have not compared the tissues of potato plants with this view.

2292. At any rate, there has been no attempt made at present to trace it?—No.

2293. Was not there some theory that the hair on the leaf would keep off the spores?—I have read of such a theory, but I think it is absurd, a hair is such a totally different thing in size from a spore; on this drawing you will see a hair, and also a spore enlarged to the same scale, and it is impossible to conceive that a hair or any number of hairs would have the slightest effect in keeping off a spore: 10,000 spores or more would easily find room for themselves inside one hair. Besides spores often gain access to a plant by piercing into the hairs in the first instance.

2294. Beyond the general health of the plant, do you think that a new variety of potato plant might develope some quality that would resist the disease, such as a thicker skin?—I think that is very reasonable, and very probable.

2295. That may be arrived at, if we experiment for new varieties?—Yes.

2296. What would you say was the best plan on the whole for lessening the disease; should you say it was encouraging new varieties?—Yes, encouraging new varieties, and encouraging and teaching growers to cultivate their potatoes in a proper manner, and burning all potato refuse.

2297. Teaching them would merely mean supplying them with information, or would you have any legislation, with penalties?—That is a subject I cannot advise upon.

2298. Would it be worth while making every man burn the stalks, for example?—I should think that would be very advisable indeed.

2299. And where you had a population of small farmers, with regard to whom mere information would not make them burn their stalks, would it be advisable to pass a law that they should burn the stalks by a certain date?—I believe it would have a very good effect if all potato growers were compelled to burn their stalks and refuse.

2300. Would you recommend that after a certain date no man should be allowed to keep diseased potatoes in store in the potato sheds, or in heaps?—Badly diseased potatoes are seldom preserved, they are generally thrown on to the manure heap or given to cattle, whereas they ought to be completely destroyed.

2301. So that it would be impossible to legislate for the tubers themselves, but it would be possible to legislate for the stalks?—Diseased tubers, as well as stalks and decayed foliage, should always be burnt.

Mr. *Earp.*

2302. How do you think the potato would be perpetuated in its natural state, say in Peru, and before it was considered cultivatable; do you think it was by means of the seed rather than the set?—Yes, probably; though it is by no means uncommon for wild plants to propagate themselves by an underground stem.

2303. And it would be therefore probable that it has survived in consequence of its reproduction

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tion by means of the seed?—Possibly, but very little is known of the potato in a wild state in South America.

2304. But that we, in our treatment of it you think, have departed from that method too much?—Yes, in cutting up the tubers is unnatural; so is placing them upon rank dung.

2305. And you think the sooner we hark back as it were to a more natural system the better?—That is my opinion.

2306. Do you know whether there is any record at all of the evidence of deterioration in particular sorts of potatoes; has there been any analysis of potato sets year after year of one particular sort grown under similar conditions, so as to show us in what way the deterioration manifests itself in the chemical properties or qualities of the potato?—No, I am not aware of a series of experiments of that nature; although I believe Mr. Lawes, of Rothansted, and possibly the Duke of Bedford, at Woburn, have something of this sort in hand.

2307. Do not you think it is most essential they should be made?—Yes, on a large scale.

2308. We have no history of the disease, in fact, excepting as a large phenomenon; that is to say, a constitutional history of the disease in the potato itself, by which we could trace its deterioration?—No.

2309. Do these experiments and methods, which you and other witnesses have so much recommended, were undertaken by the Government, do not you think it is most important that that kind of scientific evidence should be put on record?—Most important. I have stated that generally in the paper I read.

2310. I do not know at all whether you have had much practical experience of the growing of potatoes; have you said anything to the Committee with regard to the nature of the soils, and the treatment of the soils, and the methods of manuring?—I have generally adverted to these, such a subject is so vast and intricate that it would occupy an entire day to go into one only of the branches mentioned thoroughly.

2311. Just to simplify your conclusons, would you say it is very important, for instance, that manure should have assimilated itself thoroughly with the soil before the potato set is brought in contact with the soil?—Yes, that is very essential.

2312. That is a point, I think, which has been generally entirely overlooked in the treatment of the potato?—It so appears to me

2313. Should not you say that, generally speaking, the potato has been grown under conditions as unfavourable as possible?—That is what I have said in the most emphatic way.

2314. And the only method to endeavour to counteract that and to bring about an altered state of things, and to secure immunity from disease, would be for Government to pioneer improvements?—Yes, I have suggested that.

Mr. *Arthur Moore.*

2315. You speak of wishing to see the manure assimilated with the soil; supposing you plant your potatoes about the usual time of the year, which I suppose is March, when would you like to see the farmyard manure put into the land; in the spring or the autumn?—With greater advantage the previous autumn.

2316. So that it should be well worked up with the land?—Yes.

Chairman.

2317. Have you got the resting spores out of the ground one or more years after the potato had been grown in that soil?—I have got them out three years in succession; expressed them from the earth.

2318. And in considerable quantities?—Yes, they are common where potato refuse is thrown on to the manure heaps.

Mr. *Arthur Moore.*

2319. You have detected the spores yourself and submitted them to the microscope?—Yes, repeatedly.

2320. Supposing a poor cottier has only a small patch of garden, as they call it, and he at present grows potatoes there every year, but wishes now to try and stamp out the disease; what crop would be the most likely to put an effectual stop to the spread of the disease following potatoes?—No kitchen garden crop will contract the disease, except the potatoes themselves, or an allied plant to the potato, like the tomato; this plant, however, is not likely to be grown by a cottager.

2321. Then any other crop like oats or cabbages would be desirable; the only thing is the crop must be changed?—Yes, if the crop is changed, the change always works beneficially.

Mr. *Colman.*

2322. Is the tomato subject to the disease?—Yes, very subject of late years to the potato disease. Entire crops of the tomato have been destroyed during the last three years.

2323. Is it a similar disease?—Yes, it is the same with the potato disease.

Mr. James Legasick Shuter, called in; and Examined.

Mr. *Shuter.*

Chairman.

2324. You are a potato salesman from Farringdon Market, in the City of London?—Yes.

2325. And you have had considerable experience in home and foreign growths of potatoes?—Very large.

2326. Do you, amongst your potatoes, get potatoes diseased?—Very much so.

2327. How do you separate them for the purposes of sale, or do you separate them?—We do separate them. They are usually put into heaps for a short time, in order that the disease, which was scarceley visible in many of them, may become more fully developed, and so render it easy to sort out those which are sound and fit for sale.

2328. If you leave the good potatoes and the diseased potatoes in a large heap together, the bad ones rot away and do not communicate the disease to the good ones?—If they stop long enough for those diseased to become decomposed, those which were good may become rotten; but if left there for a short time, the disease which is already

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in the tuber, developes itself to so great an extent that it can easily be seen, and the diseased ones separated from the others.

2329. So that your habit, if you get a quantity of potatoes of which some are diseased, is to leave them, how long?—They never come into my hands in that way. We find some few diseased now and then. The farmer or grower puts them in heaps, and is then able to separate the diseased from the sound ones, and then he sends the sound ones to market, or those he presumes to be sound, but invariably leaving some which are diseased amongst them.

2330. And those you are able to separate afterwards?—The buyers separate them themselves; or if they are washed, which is sometimes done, then those which are diseased very readily show themselves, and the sound ones can be taken away.

2331. Have you found any very great difference in the liability to disease of the different varieties of potatoes?—Yes, some of the late varieties, or those which have been recently introduced here. For instance, the Early Rose is one in which disease develops most readily and not only becomes diseased, but it rots very rapidly. Regents have of late years become very much subject to disease, as have also Victorias and Flukes.

2332. Are there any other kinds which come under your observation?—Early Myatts in many cases become entirely diseased, especially the variety which has perfect flowers.

2333. On the other hand, would you give a list of those potatoes which you find more than usually free from disease?—During the last three years the Champion has been most free from disease; the Sutton's Flower Ball has enjoyed fair immunity from it; the Magnum Bonum has also enjoyed tolerable immunity from disease; and Myatt's Prolifics have too in some localities been almost free from disease; while in others they have been, I might say, totally destroyed.

2334. Would you say as a general rule that the potatoes in the London market are of some distinct variety or type, or are they of a mixed mongrel variety?—As a rule they are of a distinct variety, and the public is really the best judge of the variety which suits it for food. The Regent is by far the best when sound. Its nutritive value is much higher than that of most other varieties, and it is not only that its nutritive value is higher, but the nutrition contained therein is so easily broken down, and so easy of digestion, that it is very much esteemed.

2335. Would you say that the potatoes as a general rule in the London market are of some distinct variety; are they Regents or Flukes?—Regents, Victorias, and Flukes are the principal varieties.

2336. Do you ever have potatoes coming for sale that you really could not say were of any variety at all?—No, I think not; I think most of those that have come to hand we know very well indeed.

2337. Are you able always to identify that sort of potato and say they belong to Victoria or Regents?—Yes, and can almost say where they come from as a general rule.

2338. What part of the country do you get your potatoes from chiefly?—Scotland, Yorkshire, Kent, and Essex. I get a very large quantity from Kent.

2339. Is not there a very large quantity of potatoes grown in the south-eastern parts of Essex?—Yes.

2340. Do you know of any peculiarity about the manure they use in south-east Essex?—They mostly use farm-yard manure, and some of the artificial manure supplied by chemical manure manufacturers.

2341. Do not they use sewage manure to some extent in Essex?—Only at Romford, at the Hope Sewage Farm, I think. I do not think they avail themselves much of any other.

2342. Is there any difference in the liability to disease in those different districts?—The lands which lie lowest are more subject to disease than the uplands; that is to say, lands which are easily drained suffer less from disease than those where the drainage is bad.

2343. Is there more immunity from disease in the earlier portion of the season than the later portion?—Yes.

2344. Do you think it would be possible and desirable if potatoes could be made earlier?—No, and for this reason. All the early varieties of potatoes do not keep, or rather they keep sound, but they do not keep as being fit for food. They become black and people will not use them. You never can get people to eat Myatts say in the months of October, November, or December. You require a potato which will keep well, will keep its quality, and is not liable to germinate, because when the process of germination goes on there is conversion of the starch and the cellulose.

2345. Do you believe a potato that could be produced early in July, would not be a lasting potato for the whole of the winter and the spring?—I think it is perfectly impossible.

2346. You think it would be impossible to grow a potato that would come in early in July, and keep all through the winter and the following spring?—Quite so.

2347. Do you think there are any conditions of the atmosphere favourable to the development of the disease?—Electrical states of the atmosphere. When there is a highly electrical state of the atmosphere ozone is formed, and very often I believe nitrous acid, and that is very favourable indeed to the development of all parasitical germs.

2348. When you speak about the electrical condition of the atmosphere, have you made any direct experiments?—No, my knowledge is derived from observation only.

2349. Your observation is this, that disease follows a thunder-storm as a rule?—Disease most frequently follows thunder-storms, more particularly in the autumn.

2350. But you have no direct experiments to show whether that is due to the wet and heat, as has been suggested, or whether it is due to the electricity?—Inasmuch as moisture generally accompanies highly electrical states of the atmosphere, and the atmosphere is more highly charged when there is much moisture, they are so associated that it is rather difficult to separate them.

2351. You do not suggest in any way that we should study the electrical conditions of the disease, to lessen the disease by any electrical appliances?—That is not the way I think in which

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which the disease is to be attacked or prevented. It is only a condition favourable to the development of the disease, but we have to look to the hygienic condition generally.

2352. I think you heard most of the evidence of Mr. Worthington Smith; do you agree with him as to the way in which disease is first developed, that it attacks the leaf first?—The leaf is attacked. I was examining some on Wednesday last, and there I saw the disease progressing very unfavourably.

2353. Where did you see the disease then?—In Kent.

2354. Is that earlier than it generally shows itself?—No, it very frequently shows itself quite as early as that. In fact, I saw disease this year in the month of May on other plants.

2355. On the whole, would you say that the crop looks well this year?—The crop looks remarkably well at present. Here is a potato haulm which I have brought, and that looks particularly well. I brought it for another purpose.

2356. Do you think there would be any use in cutting or getting rid of the stalks at any time of the year?—After the potato is dug, I think it would be very beneficial indeed, for this reason. The potash contained in the stalks would form very good manure, and I have seen that where stalks have been burnt, and I have called the attention of growers to it, on that very ground they have grown potatoes the next year and they have enjoyed perfect immunity from disease.

2357. Then you think it would be very advisable that the stalks should be burnt each year?—I think it would be very advantageous. I do not think it would be so advantageous for the purpose of getting rid of disease in that way. If you take plants and animals generally, you never find parasitical growth in a perfectly healthy condition; it is only where there is feeble health that you find parasitical growth throughout the whole of nature. That is what we have to look at; at the hygienic condition of the plant, and the best way of producing that. To give you an illustration, I went into a field last year where there were Regents growing, but some few Champions. The Regents were struck down by disease, and were nearly a total loss, while the Champions, in the very midst of them, some few stray plants, were without a trace of disease in them. They were subject to exactly the same conditions of atmosphere, the same ground wherein the others were grown, and yet they enjoyed immunity from disease. To my mind it was very apparent why; that plant had a better physical condition. That is what you have to do, not wait for new varieties, which of course is a very good thing, but to create a better physical condition of the sorts that you now have. For instance, with regard to Regents, the best known potato we have ever had in this country perhaps, you have to seek to create a better physical condition, a better hygienic state, and then that will enjoy immunity from disease, as it did for so many years.

2358. How would you make it healthier?—Following my observations in this way, leads me to a conclusion or a suggestion. As a rule, where potatoes have been grown, say this year, they are ploughed up, the ground harrowed, and there is sure to be some few left in the ground. They will grow next year. I have seen that, and I have never in any instance seen those diseased. The fact is, it comes to a question of overcrowding.

2359. That is the second year when they grow accidentally, a "voluntear crop" I believe the growers call it?—I believe it is so called.

2360. You never have seen them diseased?—I have never seen them diseased, and have never yet been able to find anyone who has.

Mr. Colman.

2361. You mean growing with other crops, not with potatoes?—Yes.

Chairman.

2362. What is the reason of that should you say?—If you place a number of children in a nursery, you will find they will not thrive so well as one or two will, and that would be my answer; that is to say, the potato is placed in the most favourable circumstances for its development and growth, and in that way it is entirely able to resist disease.

2363. What practical deduction would you draw from that; would you plant potatoes further apart, or would you only plant them further apart for the purpose of procuring seed for the following year?—I should plant potatoes further apart for the purpose of getting a crop, because you get better crops in that way. I should also plant them very much further apart for the purpose of getting seed, but unfortunately farmers plant them as closely as possible where they want to get seed. They grow them for seed under the most unfavourable circumstances, because if they plant them very close together, they get a crop of very small potatoes instead of really taking the finest. Farmers, generally speaking, and growers of potatoes, look at potatoes as a sort of fruit, but they are nothing of the sort. The potato is simply an underground stem, from which you can propagate by budding the stem, as you can from the young wood of a tree; by planting it you can propagate its species.

2364. Then would you turn the attention of the purchasers of seed rather to making the present varieties of potatoes healthy than to producing new varieties?—I should do both certainly; but in producing new seed it is necessary to know exactly what you are about, and to produce new seed systematically. There are gentlemen who have paid a good deal of attention to hybridisation, and they know the way in which they would be able to get seed; but now it is left to mere chance. They take the potato apple, break it down, and got the seed from that and grow it, and therefrom get a number of varieties; but in getting new varieties it is also necessary to be exceedingly careful in selecting them, so as to get a variety which would be likely to suit not only the public as an article of food, but also a potato that would last for many years, and the only way of doing that is by getting a variety which bears abortive flowers.

2365. You mean a non-flowering variety?—It flowers, but does not bloom, if I may put it in that way. Here are two plants which I have brought for the purpose of illustrating what I mean. Here, you see, is one which has abortive flowers; this is a plant of the Regent potato.

Mr. Earp.

2366. Would those flowers open at all?—No, they drop off.

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2367. What is the reason of that?—Because they are abortive flowers. You see there is the form of the ovary.

2368. They have not been impregnated?—No, they never would impregnate; there is no pollen. If I were to break it down and show it under the miscroscope, you would see it, whereas this other plant is in the most perfect condition. Here you have the anthers which contain the pollen, and there is the ovary, and then when that becomes impregnated it grows and forms the potato apple which contains the seed.

2369. They are impregnated from each stalk?—The anthers impregnate the stigma.

2370. What supplies the ovary?—These anthers are covered with pollen. The stigma contains the style and the stigma. The pollen comes from the anthers to the stigma, and that then becomes impregnated, and so soon as that is impregnated these flowers close up, and the pollen, which undergoes the change, passes down the style into this ovary, and that becomes impregnated and immediately begins to develope. But this variety of the Regent is really a standard variety, and only needs to be cared for to continue what it has hitherto been.

Chairman.

2371. What is the name of the variety of the Regent you are referring to?—Simply the Regent. There is the Red Bog, which was raised from the old American Early.

Mr. *Stewart.*

2372. Is is not the fact that the Regent never deteriorates?—No, because the flower is abortive. It therefore never becomes impregnated, and undergoes no degeneration.

2373. Is that the only variety of potato which does not bear fruit?—It is the only variety I know of that is commercially grown.

2374. It is the only variety that does not bear any green berry?—Well, there is an Ashleaf Kidney which bears no berry, and that is equally permanent. You find them very much sought after, because they take disease less than others.

Chairman.

2375. You believe that there are special varieties bearing abortive flowers which do not degenerate, though they may be a long period absent from the seed?—They do not degenerate at all in their character. The Regent is the same to-day as it was 36 years ago, when I remember it very well indeed.

2376. Do you consider that the Regent is more liable to disease now than it was 36 years ago?—Yes, it is practically.

2377. What do you attribute that to?—Because it has been grown over and over again, and so forced that it has become feeble in health.

2378. Which would be practically the easier: to develope a new or a healthier variety of potato, or to restore the Regent by judicious cultivation?—Restore the Regent, that is to say, select from Regents as they are growing the finest varieties, which, if the Committee would like to see practical illustrations thereof, I can give them a very good one if they would go to Wooldham, near to Rochester, where you could see potatoes growing in the most beautiful way possible, cultivated in the most perfect manner that was ever seen, by a Mr. John Scott. You would there see the growing potatoes perhaps better than anywhere in England or Scotland. He has some fields now of a variety which he has given another name to, but they are taken from the Regents which he has selected, and they are really superb.

Chairman—continued.

2379. How did Mr. Scott develope this new variety?—From selections from the Regents.

2380. By selection of tubers?—Yes, when growing. For instance, he would say, here is a very fine plant; just the same as you would do by stock, you take your finest animals, and you would breed from them.

2381. Then, as I understand, Mr. Scott, in successive years, has selected the healthiest tubers and developed a healthy variety?—He has now got such a fine variety, and in sufficient quantities to put large fields under cultivation. I think it would amply repay the Committee if it would go down and visit this farm. I have his authority for saying that he should be very happy to receive you, and show you the whole of the cultivation. His farm is some two miles from Rochester.

2382. Are there many men in England and Scotland whom you know who attend to the production of seed so as to produce healthy varieties?—I think not, and then it has only been done in a casual sort of way. They take the potato apple and plant the seed therefrom, without having previously impregnated them, or I might say, hybridised them in an artificial way. They have left them entirely to the bees or other insects.

2383. In fact there are not many men who attend to that department?—I think not.

2384. Would it be a paying department of agriculture?—I do not think it would.

2385. But still it would be a very useful one for the community?—Exceedingly useful.

2386. Do you think it is a department of agriculture which the Government might fairly be asked to subsidise or help?—I do.

2387. And you think a certain amount of money spent by the Government in encouraging the development of new varieties of potatoes, or strengthening old varieties of potatoes, would be very well expended?—Very well indeed.

2388. Have you any suggestion to offer as to how the Government could assist in the production of healthy varieties?—Find some three or four practical farmers, intelligent men, who have got various kinds of land on their farms, and pay them a very small sum for the use of their land. Any intelligent farmer would be very glad to aid the Government in that way, and then appoint some two or more persons to visit those farms occasionally, make their suggestions, and point out what they would wish done.

2389. Do you mean in growing seed from the tuber, or to produce new varieties?—To produce new varieties, and also to cultivate the existing varieties.

2390. Would not the production of new varieties from the seed be more in the way of a nursery gardener or a seedsman than of a regular farmer?—Well, my experience of seedsmen is that they do not know much about it. They may, so far as a knowledge of horticulture and the raising of varieties goes, but they do not know the requirements of the public.

2391. Could

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2391. Could you tell us what variety of potatoes you think retains its best properties longest?—The Victoria has hitherto done that, and even so this last year.

2392. It would be a sounder and better flavoured potato later in the spring ensuing after its growth than any other?—It is so. The Champion was said to be a late potato, but it is not. It is now coming much earlier, and it does not keep well. It grew very rapidly at the early part of the spring, and therefore the whole of the starch, or nearly so, was taken out of it.

2393. Then do you associate the period at which the potato arrives at maturity with the duration of its other properties?—Quite so.

2394. And you think the later the potato is lifted the more likely it is to last?—The later it is coming to maturity, and the later it is lifted, consistent with lifting it before the frost comes, the more chance it has of remaining good and fit for edible purposes in the spring. I have heard something here said about the Flour Ball; I hope that not much attention will be paid to that, because it is a potato which contains but little nutrition, and the nutrition which therein is, is exceedingly difficult to get out. Then the Champion, again, although tolerably free from disease, is a potato which is of a very second-rate quality. It is only of good quality when grown on very good land, and the starch developed very well. It contains vast quantities of cellulose, and is exceedingly difficult of digestion.

2395. Is not the Fluke largely consumed in London?—No, there is no potato sold so largely as the Regent and the Victoria, except during this last year, when German Reds have been largely imported, and they have been eaten in preference to the Champion by the majority of the public.

Mr. *Stewart*.

2396. The Champion is rather gaining in popularity, is it not, owing to its improvement?—With the farmers, because it enjoys immunity from disease, but for the general public as regards food the Champion will never be highly esteemed. Last year there was a very large quantity of Champione in the market, but the general public prefer the German Reds, because the nutrition therein contained was very much higher, and it was very much better in flavour.

2397. Is the Champion not better than it was some two or three years ago?—Yes.

2398. Year by year is it not improving in quality?—I think not generally; something has been asked, I think, about manure. I have had a series of analyses of potatoes made.

2399. Will you tell me the respective analyses of the best potatoes which are at present in the market, or some of the varieties of the potatoes which are in the market?—The analyses I have here are the Champions. I have no analyses now of Regents, but I can tell you what the quantity of starch relatively is between the one and the other. Good Regents will yield something like 20 per cent. to 22 per cent. of starch, and Champions about 17 to 18 per cent.

2400. And Rocks?—They are very low in quality; they were at one time very fair quality. They yield a large quantity of cellulose, which would break down very well under extreme heat or acid, and therefore would serve for the purpose of distillation; is not easily assimilated as food. In fact, if children eat these potatoes they pass through the body almost unappropriated.

Mr. *Stewart*—continued.

2401. Have you any further analyses there?—The difference between diseased and undiseased potatoes is very curious. I was pointing out to Dr. Voeteker the other day that the potash salts contained in sound potatoes was 39·453, and the potash salts contained in the diseased was 50·222.

Mr. *Barclay*.

2402. That is in the ashes of those plants?—Yes, and in the sound potatoes there was 18·707 of starch, while in the deased there was about 11·702.

Mr. *Stewart*.

2403. What variety was that?—The Champion. I took the Champion particularly, because it was said to enjoy immunity from disease, which is not true, because I saw a whole field of Champions last year which was completely lost, and there was not seed enough obtainable from it to replant the ground.

2404. Where was that?—At Gravesend, Mr. Charles Smart.

2405. Could you attribute it to any local cause?—The wet season, and the land is rather low lying.

2406. Was the land drained?—Yes

2407. The Rock has been a very long time before the public?—Yes, but never much appreciated.

2408. Is not that rather against the theory that a potato by continuous growing becomes better in quality?—You must remember that it is a flowering variety like this one I have here, and potatoes that flower all degenerate. If you grow Victorias for two or three years in the same locality you will find that they revert back, and become nearly like the Rock, instead of being long they are nearly round.

2409. Could you give the Committee any suggestions with regard to the storing of potatoes?—They should be stored thinly in clamps above ground, well covered with straw and earth; but if stored in barns or in cellars they would rapidly become black, and not very fit for food.

2410. Then you do not approve of the system of storing seed potatoes on shelves?—That is another matter; seed potatoes do very well stored on shelves, or as they do in France in small trays, they make small trays the depth of the potato and lay them on one another, and pile them up in their barns, but that is more particularly for early potatoes than for late.

2411. You never would advise the bulk of the crop to be stored in that fashion?—No.

2412. Is that on account of the expense and difficulty connected with it?—No, I think they would degenerate; they would grow too much, and would exhaust themselves.

2413. Why should it be better to store the seed potatoes in that way, and not the remainder of the crop?—That is for early seed potatoes only, because so soon as they germinate, and there is a plant almost formed upon them, a good shoot, then they are planted in the ground and grow very readily. In fact they are stored almost in a hot bed.

2414. Does your experience go to show that there is any marked difference between potatoes

Mr. *Stewart*—continued.

grown in farmyard manure and artifical manure?—Farmyard manure, I think, on the whole is best; but in certain lands they would be better assisted by the use of potash and some superphosphates. I should not recommend much ammonia, because the nitrogen is very favourable indeed to parasitical growth.

2415. Now you said you had never witnessed any instances of disease in potatoes that had been left after crops, and come up spontaneously?—I have never witnessed any, and I have inquired of a great many persons the result, and they have all said, "Well, it never struck me, but such is the fact."

2416 You argue from that that by planting potatoes at a greater width apart you would be less likely to have disease?—Yes.

2417. Is it not a fact that some varieties have been found by experience to grow better as a crop by standing them at considerable distances apart, while other varieties, on the other hand, have been found to give a greater bulk of crop by planting them near together?—No; I think, on the contrary, that you invariably get a good crop when planted wide apart. On this particular farm of which I have spoken, I know upon one occasion Mr. Scott had as large a crop as 20 tons of Regents to the acre, and they were planted very widely apart—10 or 12 inches in the drills, and in the rows from 32 to 34 inches.

2418. Then can you tell the Committee if those potatoes were planted as whole potatoes or in sets?—Whole potatoes, and planted deeply.

2419. And harrowed down afterwards, so as to enable the sun's rays to get into the ground?—I do not know,

2420. Could you tell the Committee what manure was applied to that crop?—Mostly farmyard manure, about 30 tons to the acre, and sometimes 35 tons.

2421. On the question of the agency to be employed by the Central Government to foster the better varieties to be procurable by seed by the different consumers throughout the country, would it not be sufficient compensation to those particular farmers to be able to obtain a far higher price for those seeds which they have paid the greatest attention to without recourse to any Government assistance?—You see, in order to raise seed potatoes, you must give attention to them for some three, four, or five years to select varieties, and then, perchance, at the end of that time the variety that has been raised might be almost worthless, because it might never become a good cropper or a good variety.

2422. But still, seeing the fact that a very good variety fetches a very high price in the market to be used as seed, you do not think, as I gather from your last answer, that it would be a sufficient encouragement?—I do not know, but I am quite certain that it would be very easy indeed for the Government to get some few men in the kingdom who are accustomed to potato-growing—taking care that they are intelligent men and good farmers, and know exactly what they are about—to undertake any work of that kind at a very small cost.

2423. Do you find that the public prefer an English or a British grown potato in preference to a foreign grown potato, as a rule?—Yes, because the English grown potato is always better grown than any you get from abroad.

Mr. *Stewart*—continued.

2424. Those coming from abroad are a coarser variety?—The English potatoes are a better size and more suited to the general taste of the public. The English public do not like very small potatoes. Abroad they generally grow very small potatoes, unless they grow them for feeding purposes, and then they are a very coarse variety.

2425. I suppose the most profitable potatoes in the London market are the Regents or the Dunbar Reds?—The Dunbar Regents, grown in red soil, consequent upon the iron in the land.

2426. You have nothing further to suggest to the Committee which could diminish the extent of the disease and improve the crop except by improving the seed?—Improving the stocks, which might be done, if men were to give their attention to it, by selecting the finest plants or stocks in a field growing. Say, for instance, there is a large field of Regents now growing. There is always some few which are better plants than the others. That variety should be taken and carefully cultivated by itself.

2427. That is very much the same system as is now adopted by securing pedigree oats and pedigree wheat?—Quite so.

2428. Are you conversant with the system of Major Hallett, of Brighton?—No. I think it is the proper way to do it; to select artificially instead of leaving it to natural selection.

2429. You think, in that way, you would get a stronger constitution potato, and so thereby greatly diminish the disease?—I am sure of it. There was the American Native, which was well known before the Regent, and a variety was selected from that and grown at Red Bog farm, and the potato cultivated from that became the Red Bog of commerce, which has been really a very great favourite for many years, and now there are some varieties of it growing in the most luxuriant condition possible.

2430. Where potatoes are grown year after year, have you any experience that by adding to the soil in which they are grown, the constant quantities of potash which they are supposed to draw from the soil, you can continue to grow those potatoes free of disease?—I have never had any experience in that respect. From experience in other matters we must remember that no plant can be grown to maintain all the conditions necessary to its welfare unless the food necessary for that plant be in the ground, and if you take from the ground by any one crop, that which is necessary for its welfare, you must at some time or another, if you wish to grow a similar crop, again add to the land that which you have taken from it.

2431. You have no suggestion to make in regard to preserving the crop of early potatoes from the frost?—No.

Mr. *Arthur Moore*.

2432. Have you any practical knowledge as a farmer yourself?—Only from being very much about the country, and my general observation from visiting farms.

2433 And purchasing?—No; I never purchase any potatoes.

2434. I thought you were a dealer in potatoes?—I am a salesman; I do not purchase potatoes except for one branch of my trade. I purchase varieties of seed occasionally when I have

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have had the stocks. I generally get some seed of the finest varieties.

2435. I think you have said that the flowering potatoes degenerate?—Very rapidly.

2436. What is the reason of that?—Because they become hybridised by other varieties; they are crossed, in fact.

2437. Other varieties are spontaneously produced?—The impregnation of one potato by another degenerates more or less that which is impregnated.

2438. Where do the potatoes come from abroad, which are sold in the London market as a rule?—In the early part of the year, Lisbon, Malta, then Jersey, then Cherbourg. Some have come from Italy this year.

2439. And from Belgium?—Yes, also from France, Belgium, and Germany.

2440. Which potato is the most free from disease of the foreign varieties that come?—This last year the German potato has been the most free.

2441. What is the name of that?—The German Red.

2442. What part of Germany does that come from?—Every part.

2443. Has that enjoyed immunity from disease for some years past?—I think so. It has been grown there for many years for the purposes of distillation.

2444. You have spoken about the effect of a thunder-storm; you think the electrical condition of the atmosphere has to do with the spread of the disease?—Yes.

2445. You have no information which would lead you to distinguish as to whether that effect followed from the electrical condition of the atmosphere, or on the other hand from the mere presence of heat and moisture?—The atmosphere is always more or less in an electrical condition, but the electrical condition when we have a thunder-storm, and the moisture probably contributes very much. I have always found the disease has spread much more rapidly, or rather the mycelium, which grows and is the cause of the disease, has developed more rapidly after a thunder storm, exceedingly so. In the case of a thunder-storm falling to-day on a field of potatoes which is already affected by disease, if you were to visit it to-morrow, you would find all the field black.

2446. You have no proof to offer that that does not follow from the heat and damp and not from the electricity?—Except that some experiments were made some time ago by a gentleman, which I heard of, where he kept the plants entirely covered from the rain and the thunder-storm, and then he had used nitrous acid to the plants. Those which were surrounding those which were protected rotted very rapidly, and those covered were perfectly free, but when he used the nitrous acid those plants became equally affected with those which were surrounding. Therefore, we may say that the nitrous acid supposed to be generated in a thunder-storm is favourable to the development of the disease.

2447. Where were those experiments made?—I cannot tell you now. I remember reading of it some years ago. I do not know whether it was not a Mr. Worthington Smith.

2448. You said that it was a desirable thing to keep up the physical condition of the potato in a state of robust health. What means would you take towards that?—Proper food, or proper manure, and sufficient ground wherein to grow them.

Mr. *Arthur Moore*—continued.

2449. You spoke of the Flour Ball potato; I think that is Sutton's Flour Ball?—Yes.

2450. You said it had a very small quantity of nutrition?—The general public will not buy it. If you have it in the market you cannot sell it.

2451. Are you merely saying it has a small amount of nutrition, of your own judgment, and the practical decision of the public is not buying it, or has there been a scientific analysis made?—I made the analysis myself, and could get but a very small quantity of starch from it, but it has a large quantity of cellulose.

2452. Did you make an analysis yourself?—Yes.

2453. A good many witnesses have told us that different varieties of potatoes have a life of great health for a certain period, and then after that period a particular variety tends to degenerate, and, roughly speaking, 20 years has been put down as the lifetime of a variety of potato; does your experience tally with that?—The Regent has been in existence, I should think, now nearly 45 years, and it is as perfect in its character now as it was when first grown.

2454. What about its liability to disease?—It is more liable to disease, but that is in consequence of its being very badly selected and very badly grown. If they were to take the healthiest of those tubers, and generally obtain their plants from those healthy tubers, they would continue the variety in as perfect a condition as it was many years ago.

2455. Have you ever heard anything of a potato called the Skerry Blue?—Yes.

2456. Is it a good kind of potato?—It is almost degenerate.

2457. Would you recommend, from your experience in the planting of potatoes, that the potato should be planted whole or cut in sets?—Whole when small, and in certain lands you may take sets, but in the other lands, if you take sets, where the land is wet, they rot before they begin to germinate.

2458. You think there is less liability to rot where the potato is whole?—Quite so.

2459. Do you recommend a change of seed from time to time in given pieces of land?—Change of seed from one place to the other.

2460. If you have but the one place where it is convenient to plant potatoes, I suppose you would bring a different variety from time to time?—Not a different variety; the same variety, but from another locality. I would draw your attention to this, which is, I think, very important. I do not think it is very wise at any time to plant a potato which is rich in starch, not a very high quality, for when it has attained its maximum then does it seem to decline if it is grown in the same locality; but if you take the same potato, grown in some of the few lands where the potato grows a small quantity of starch and a large quantity of cellulose, which is exceedingly necessary in vegetable growths, and plant that potato inland where they usually grow a high quality, then you get the very best possible condition of things; but farmers, as a rule, are very careless indeed in selecting their seed.

2461. What you would like to see then, and what you maintain can be done, is this, that a

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potato can be kept in a high state of health by always selecting the very best specimens out of the field for seed, and planting them with the greatest possible care?—Yes.

2462. And you think the life of the potato may be advantageously prolonged by that?—I think the life of the variety which bears abortive flowers can be continued for any length of time.

2463. And the Regent is such a variety?—Yes.

Mr. *Colman.*

2464. In speaking of sewage manure, did you refer to liquid sewage, or to matter which had been deposited from sewage?—I am not yet aware of any good manure being deposited from sewage.

2465. Then you meant liquid manure?—No, I have not mentioned anything about liquid manure, I think.

2466. You said something about sewage with reference to manure; you said that some potatoes in Essex were grown by sewage?—I think the Chairman asked me something about sewage manure. I said I did not know of any being used except about Romford, on Hope's farm.

2467. Was that used with potatoes?—They have grown a variety there.

2468. You do not know whether that had any effect in increasing or diminishing the disease?—I do not know.

2469. With regard to Mr. Scott's farm, are you able to tell us that not merely this year he has such a fine crop, but that during the past few years he has been free from disease?—He has not been totally free from disease, but he has enjoyed fair immunity from it.

2470. Less than his neighbours?—Yes, and his crops are certainly the finest in the whole of Kent.

2471. And you attribute that mainly to planting widely apart?—Widely apart and good cultivation; he cultivates his potatoes.

2472. And I suppose changes the soil?—Changes the soil and seed. He is exceedingly careful about his seed, but from observations which he has made, he is going to continue the course which I have suggested, that of selecting the finest varieties from the variety which he may be growing.

2473. Are you able to say what time of the year he has put his manure on the land?—He puts his manure in early as it should be.

2474. Do you mean in the autumn or early in the spring?—Early in the spring, but he now thinks with me it should be put on in the autumn, so that it may become assimilated with the land, or digested, if I may so term it, because it is an error to suppose that manure can be taken up into the plant in the form in which it is put on the land, or to think that if you put on potash it goes in that same form into the plant. It does not do anything of the sort. It must undergo a process of decomposition, and of assimilating itself with the land, it must be digested, if I may so term it, so that it may be readily taken up, because there is no doubt that the land itself has a vitality.

2475. Then you are pretty certain if he were to plant half of his field closely as it is ordinarily planted and another part wider apart than they are planted as a rule, the one would be very much more diseased than the other?—Well, I

Mr. *Colman*—continued.

think it is possible, but you see he would do this. Where they were widely planted he would have an opportunity of selecting the finest varities, and he would select those and use those varieties for cropping purposes.

2476. What is the greatest weight of potatoes he has grown in one year?—Twenty tons to the acre, 16 tons of marketable ware, and four tons of smaller, green, and fit for seed.

2477. What is that worth per acre in an ordinary year?—I think he realised 60 *l.* an acre for them.

2478. With regard to what is called I think, the Volunteer Crop potatoes, do you know what they were, grown amongst a turnip crop or a corn crop?—Both.

2479. And in all instances they were free from disease?—Yes.

2480. Have you ever seen them grown with beans?—I do not remember that I have.

2481. I ask the question because some experienced grower said he had tried them growing in this way, one row of potatoes and one row of beans with great freedom from disease, and he attributed it to the fact that the bean crop struck its roots deep and drained the soil?—The bean crop takes out much potash and nitrogen from the soil.

2482. That would not be quite the theory, because the potatoes would want the potash?—Perhaps there was an extra quantity.

2483. In one case they attributed freedom from disease to that?—We do not know so much as we ought to know about the nutrition of plants. We know now all about the nutrition of animals, and if we had looked at one, the same as we have the other, we should have arrived, I am sure, at very beneficial results.

2484. Are you able to tell us, as a rule, whether there is more disease abroad than in England; take a series of years, because last year we know they were better abroad than here; is there more disease in England than abroad?—Yes.

2485. What do you attribute that to?—The greater quantity of rainfall.

2486. It is not a question of cultivation?—And cultivation, of course, at the same time where the plant comes to maturity quickly, then it is less liable to disease; and in Germany the plant comes to maturity quicker than it does in England; they grow quickly; they ripen quickly; and they have plenty of sunshine, much more than we do.

Mr. *Barclay.*

2487. Have you any practical experience yourself in growing potatoes?—Not as a grower, except from observation on farms where I have frequently been.

2488. You have observed the practice of farmers on those farms where you buy potatoes?—From where I have them to sell. I never purchase any except for seed purposes, and I always find that farmers have a great objection to pay anything like a good price for seed; they would rather put up with what they have got of their own, and grow it year after year, than pay a price which seems to them extravagant to bring it from a long distance.

2489. You have not been able to persuade the farmers of the great advantage of changing or

selecting

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Mr. *Barclay*—continued.

selecting their seed?—Some few know the advantage of it.

2490. I thought you said just now that farmers, as a general rule, had very great difficulty in being persuaded of the advantage of changing their seed?—A great many of them.

2491. But one or two have done it and have found the advantage of it?—Thirty per cent. of them know it very well and they adopt it.

2492. We are to understand that in your opinion one-third of the farmers do put themselves to the trouble of selecting the seed which they plant?—Yes.

2493. Have you any experience of winter manuring that you are recommending?—I have no experience of it, but I believe the winter manuring or early spring manuring would be very much better than manuring immediately before they plant the potatoes which many of them have done.

2494. In what respect would the winter manuring be better?—Because the manure would become more assimilated with the ground, and would undergo the change which is necessary to render it in a condition fit for the nutrition of the plant.

2495. You have no experience of that?—No direct experience.

2496. Would you be surprised to learn that it has been tried by careful experiments and found not to be so advantageous?—I should be surprised.

2497. Do I understand you aright that you have made analyses of potatoes?—Yes.

2498. Can you submit any such analyses?—I have some here.

2499. Is that a complete analyses, or is it a chemical analysis?—This is an analyses made under my own direction by Mr. Heisch, showing the whole of the organic and inorganic constituents of the diseased and undiseased potatoes of the same crop.

2500. What effect had the planting widely apart on the quantity of the crops of potatoes that you speak of?—In the instance of which I speak the crop was very much larger than those planted near together, and the potatoes were all what are called "ware," instead of being "ware," "middlings" and "chats"; the "ware" are the largest, the "middlings" are the second size, and the "chats" are the waste.

2501. How wide apart in the field were the plants from each other?—Thirty-two inches in the rows, and 10 to 12 inches between the sets.

2502. What is the usual width at which they are planted in England?—Eighteen to 20 or 24 inches in the rows and 10 to 12 inches apart in the drills. Some plant them closer than that.

2503. Are the drills or rows only 18 inches wide?—The rows are 20 to 24 inches wide.

2504. How are they planted; on the flat, or dribbled in, or in raised-up drills?—Frequently dribbled in, and at other times a furrow run out by a small plough, in which they are planted, and then covered up.

2505. How deep below the flat surface would the potato set be put?—About four to five inches. Some plant them less deeply than that, but I think there is a very great advantage in planting them deep, because in the diseased plants you generally find that the potatoes at the upper portion of the plant are more diseased than those at the lower part.

2506. Is it the usual case in the south of England that the rows are only 18 inches apart?—I do not know; I have not been there.

2507. What part of England are you speaking of?—Kent and Essex principally.

2508. And in Kent and Essex the general process is to have the rows only 18 inches apart, and sets 10 to 12 inches apart in the drills?—Ten to 12 inches in the drills, and from 18 to 24 inches in the rows. I do not know that they are ever so narrow as 18 inches. Perhaps I am wrong there; 20 to 24 inches is about the widest I have seen them planted, except in the one particular case I have spoken of at Mr. Scott's, of Wooldham, and he plants his 32 inches apart.

2509. Speaking of the crop planted 32 inches apart, which was a much heavier crop, as I understood you, were any other potatoes grown in the same field narrower in the rows, with which to compare them?—I do not think he ever plants his less than 32 inches.

2510. You said that this system of planting 32 inches in the rows produced a larger crop?—A very much larger.

2511. A larger crop than what?—Than when planted near together.

2512. Upon what experience do you speak with regard to that point?—From experience in the locality of other farms.

2513. Not upon that farm?—No.

2514. It is possible that Mr. Scott might manure and farm better than his neighbours?—Well, he does. It may be attributable to that; but then he seldom or ever has any small potatoes. He grows them all very excellent in size, fit for market.

2515. Would that be due to the manuring or the farming?—I think the cultivation.

2516. What I want to find out is this, whether there is really any actual ground for saying that this wide planting really produces a heavier crop than if they were a few inches closer?—The reason, I think, of his getting a heavier crop in the first place is that he manures highly; in the next place he is better able to cultivate, and when he moulds them up, which he does twice, putting a good by-plough in, and cultivating them in that way, he renders the land in such a condition that there is a better chance of the tubers growing.

2517. Do you know of any difference in the quality of large potatoes, and those of medium size, not the very small?—If you take a crop of potatoes, and try the quality of the small, and they are good, the large are sure to be found very much better.

2518. Speaking of small, what size do you speak of, 1½ inch?—One-and-a-half inch, and 1¾ inch.

2519. You do not call that a small potato?—Yes, certainly 1¾ inch is a small potato.

2520. Do you call a potato that just goes through a 1¾ inch riddle, a small potato?—Yes, a small potato, and generally unfit for the London market. It is a stipulated size.

2521. Are there not smaller potatoes come to maket dressed over, a 1¾ inch riddle?—They are sent but then they are sorted out and sold as middlings afterwards. The stipulated size of Yorkshire growths some years ago was that they should not be less that 1¾ inches, and in the contracts which are made abroad now you will find that the stipulations are that the potatoes are to

be

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be put on to a 1¾ inch riddle or sieve. Less than 1¾ inches are to be taken out.

2522. And if shipped of a smaller size than 1¾ inches they are to be put over a 1¾ inch riddle bar, and the smaller ones set aside?—They have not done that of late years. That used to be the custom. They are taken much smaller, but then they are sold at a much smaller price than the larger.

2523. I understood that there are potatoes shipped to London dressed over only a 1⅝-inch riddle?—Yes; that is a very common thing, especially from Scotland.

2524. I thought you said there were not any under 1¾-inch?—I say they are not a good marketable size, and any sample containing potatoes less than 1¾-inch are considered small or bad samples.

Mr. *Arthur Moore.*

2525. You spoke of your friend, Mr. Scott, always selecting the best specimens of the Regent; how does he do that; does he select the best specimens from the tuber when they have been landed high and dry out of the ground?—No; when growing.

2526. Tell me what he does?—He told me yesterday he had been going over his fields and pointing out those he considered the finest plants, and he intends taking these plants this year, as he has done for two or three years previously, for the purpose of stock.

2527. That is to say, he judges the value of the plant by the quality of the foliage?—That, I think, is invariably the rule.

2528. Does he put a mark down?—Yes; he marks them.

Mr. *Macdonald.*

2529. If the Regent were carefully picked and the seed watched, so that inferior potatoes were not put in as seeds, are you of opinion that it would still retain the distinctive features and character now as before?—Quite so.

2530. So that you cannot see, in your experience, that it is suffering from decay, or that it is one of those sorts that is likely to die out?—No; I do not think it is. It is totally undegenerate, so far as its peculiar characteristics go.

2531. The entire cause of any failure in it is want of proper sorting and proper cultivation?—Proper selection.

Mr. *Barclay.*

2532. Does Mr. Scott change his seed?—Yes, he has done. He has usually selected the finest samples he could get from Scotland.

2533. That is by looking at the tubers?—Yes; that is seeing a fine stock of well-grown potatoes and selecting the seed from that, and taking great care that the seed shall not become heated, whereby it will grow and lose much of its virtue. But he is adopting quite a different plan now, and has resorted to the system of which I have already told you, of selecting varieties with a view of maintaining the primitive state of the Regent and the variety of which he quite agrees with me is the best to grow.

Friday, 2nd July 1880.

MEMBERS PRESENT:

Sir Harvey Bruce.
Mr. Colman.
Mr. Earp.
Sir Edmund Filmer.
Mr. Macartney.
Mr. Macdonald.
Mr. Arthur Moore.
Lord Moreton.
Major Nolan.
Mr. Round.
Mr. Stewart.
Mr. Storer.

MAJOR NOLAN, IN THE CHAIR.

Professor BALDWIN re-called; and further Examined.

Chairman.

2534. ON the last occasion I gave you a paper by Mr. Murray; can you give me your opinion upon the experiment he refers to?—Well, I think it is a very ingenious experiment. What he did was this: he put slips of glass with glycerine upon them within five yards of the potato, thinking that if the spores were carried in the air they would be caught by the glycerine. He says that they were, and that he found a number of them on the glycerine, after careful examination under the microscope. If the experiment is to be relied upon, it would go to show that certainly the spores can travel at least five yards in the air. How they were carried, whether by the wind or by diffusion, or by what, of course he does not throw any light upon.

2535. Could there be any mistake in the nature of the spores when an experiment of that kind was undertaken by a scientific man?—I do not know very much of Mr. Murray as a scientific man. The experiment, I have no doubt, is one which, in consequence of what has been brought before you, will be repeated, and verified if it is right.

2536. If the wind will take the spores five yards, would you argue from that that probably the wind would carry the same spores a longer distance?—I should say if they were capable of being transmitted five yards they were capable of being transmitted a longer distance than that.

2537. But still you think that is a fair experiment on the spores properly adjusted and under proper conditions?—I will not say so much as that. The experiment was well conceived, and carefully carried out; but with my limited knowledge of the spores I differ from him, and with Mr. Carruthers. I think it will be found the disease is capable of being propagated by damp very much. However, that is a matter, as I said on the last occasion, I do not speak dogmatically upon. It is worthy of inquiry.

2538. Could you suggest any means by which the spores could have got on this glass if they were not carried by the wind?—There are so many unforseen human agencies which might have interfered; I would remind the Committee of the remarkable cases which have occurred with regard to the cattle disease; nobody has any doubt in the world now that cattle plague is infectious, and that it never appears except as the result of infection, and yet we found it suddenly breaking out in Scotland, and we found it suddenly breaking out in two spots in Ireland; when you find that the poisons of cattle diseases are transmitted so far by some human agency, then there is, at all events, a possibility of human agency carrying these spores the distance of the five yards in that experiment; I do not want in the slightest degree in making that remark to throw any doubt on Mr. Gilbert Murray's experiments in any way.

2539. Have you made out the exact list of the potatoes which in your experience are the best for the purpose of resisting disease in descending order, from which anybody can select for himself?—Yes; since I appeared before the Committee I have consulted with the agriculturist and the horticulturist at the Model Farm at Glasnevin, and this list is the result of very careful observation and experience, but it is not my own exclusively; we have consulted together, and this is the result of the experience more fully than I put it before you on the last occasion. For garden purposes I give the following as the result of the combined experience of Mr. Gray, gardener at Glasnevin, and myself. We have learned from long practical experience, that the early varieties of potatoes are the best for garden culture; they arrive at maturity early in the season, and may be dug out towards the end of July, or the first week of August; consequently they sustain little or no injury from the disease; if they are carefully pitted in small quantities in narrow shallow pits they will keep sound and good for table use a long time; after having grown a great many kinds of early potatoes, we find that the Flounder and Rough Scotch Kemp give the heaviest crops, and the most profitable for general cultivation in gardens; the Flounder in particular is specially adapted for old vegetable garden ground, whilst the Kemp does much better in a fresh soil;

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Chairman—continued.

Myatt's Early Improved Ash Leaved Kidney is in our experience the best early sort, but it does not keep as well as the Flounder or Kemp; we usually plant in the first week of February in drills 30 inches apart, using horse stable dung, rather fresh, which we find to be the very best kind of manure that can be applied to the early potato crop. I will next submit the result of the experience acquired on the Glasnevin farm by the agriculturist, Mr. Clune, and myself.

Fortyfold; an old early variety.—This is a coloured variety, round, with shallow eyes, flavour very good and firm, even when young and small, requires to be well manured, and bears manuring better than many others.

Flounder.—Gives a good heavy crop, has been a favourite on a great variety of soils, for early farm crop; cooking qualities not good however, it is liable to disease if not dug early.

Scotch Kemp.—Very extensively grown in county Dublin, comes in after Flounder; cooking qualities good; liability to disease has increased in the last two or three years.

Hundredfold Fluke.—Gives a heavy crop, but found it liable to disease last year as follows: 4 tons 17 cwt. sound, and 3 tons 3 cwt. diseased, per statute acre.

White Rocks.—Gives a heavy crop; but as much as 25 per cent. of it diseased several years.

Brown Rock.—Also gives a heavy crop; cooking qualities good; not as liable to disease as the White Rock.

Sherry Blue.—Extensively grown in Ulster; a good return; not liable to disease; have seldom known more than 5 per cent. of the crop to be diseased; if grown for a number of years on the same land the tubers have a tendency to become long and badly shaped; the eyes rather deep; in all kinds having this property there is waste in peeling; the rounder the tuber the better; keeps better than the Champion.

Champion.—Did well with us last year; compared with a few good sorts, the result was as follows:—In one field,

	Sound, per Acre.		Diseased, per Acre.	
	Tons.	*cwts.*	*Tons.*	*cwts.*
Champion - -	11	3	1	9
Scotch Down -	7	15	1	13
Magnum Bonum	7	0	0	1

In another field: Champion, 1 cwt. dug in August contained 2 lb. diseased; Skerry Blue, 1 cwt. contained 3 lb. diseased; Kemp (Scotch), 1 cwt. contained 14 lb. diseased.

Magnum Bonum.—Stood disease last year, and gave a very fair return; it is not a good table potato.

Scotch Down.—Very extensively grown in Ireland; it does not succeed as well now as it did some years ago.

Chairman—continued.

In 1875, yield per statute acre—

	Sound.	Diseased.
	Tons.	*Tons.*
In 1875 - - - - -	6	2
„ 1876 - - - - -	7	1
„ 1877 - - - - -	6	2
„ 1878 - - - - -	6½	1
„ 1879 - - - - -	5¾	1
„ 1866 the yield was - -	8½	1½

2540. You have been asked some questions about the amount of potash in seaweed; are you able to give that now; we could not get it from Dr. Voelcker?—I have not really looked it up, but quoting from memory the quantity of water is from 80 to 85 per cent. Then there would be, I should say, about 15 per cent. of solid matter, and in that, if I mistake not, there is not less than 24 per cent. of potash in the ash.

2541. Are you reckoning it as potash or potassium?—As potash; that is, the oxide. In connection with potash, I have looked into the analysis of crops, and I have made a calculation, and I find there is no farm crop that takes acre by acre, so much potash out of the ground, as the potato.

2542. You cannot give the exact amount of potash in a ton of seaweed?—It can be calculated from the two items I have given you now. I will make the calculation and put it in.

2543. I think the figures you have given are a good deal in excess of the amount of potash in seaweed, as far as they have been supplied to me?—It may be so. I am now quoting from memory.

Sir *Hervey Bruce.*

2544. There has been a great deal of stress laid on the absence of potash in Ireland, do you think there is less potash in the soil of Ireland than in the soil of England, or that more has been taken out by the mode of cultivation?—I think, on the whole, there would have been originally as much potash in the average soil of Ireland as in the average soil of England, leaving out the bog, but that the consequence of the excessive cultivation of potatoes in Ireland has been to reduce, especially in the land in the hands of the small farmers, very considerably the amount of potash required for the growth of the crop.

2545. Since your last examination, I have been told of a mode of planting potatoes that a gentleman has practised for some time, under which he suffers very little from the disease, and that is, planting the potatoes a yard apart, and also a yard apart in the drills; then, after that, he proceeds with spade husbandry, crossing them so that each potato is almost on a raised bed of its own; have you ever seen that yourself, or heard of it being tried?—No, and for this reason. I should not ask them to try it, because I may say, there would be a waste of ground; but certainly scientifically, there is no reason why that should not be strictly correct, and the explanation would be this, that the larger space you give to the plant and the more you cultivate the

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the ground, the more you favour the conditions for the healthy and strong growth of the crop. You give it loose ground; you liberate plant food by tillage, and then you give it a larger space.

2546. Your observation is exactly the same that I put to the gentleman who told me; I said, "Do not you find you waste a great deal of ground by it, and have a much smaller crop?" He said No, on the contrary, the crop is as abundant as if they were planted in the usual way"?—The value I should be disposed to attach to his experience would depend very much on the character of the gentleman. If he was in the habit of making careful observations, you would attach every importance to it, but I find there are so many gentlemen who with the best intentions are not accustomed to habits of careful observation, that they make loose statements. I do not in any way wish to throw any doubt on the gentleman you refer to, but I should be inclined, from my own experience, to say it could not be generally so.

2547. The gentleman is Mr. Wynne, the Member for one of the divisions of Lincolnshire?—It is giving nine square feet to each plant.

Mr. *Stewart.*

2548. You have spoken chiefly, I think, of the farm at Glasnevin?—My experience is not confined to that; but I have made more careful observations there than anywhere else, in consequence of its being my head quarters.

2549. There are several other Government farms, are there not, supported by Imperial help?—There are.

2550. Do you know the amount allowed per year?—Yes, this year it comes to 6,000 *l.* in round numbers, including the maintenance of buildings.

2551. That is paid out of the Consolidated Fund?—It is.

2552. Is it your experience that much good has resulted from these farms?—Well, inasmuch as I am the officer of the department, it is hardly a question I can answer.

2553. Can you point to any definite conclusions of real improvements in agricultural science that have resulted from the working of these farms by this system?—Yes, I can say this much with confidence to you, that a very considerable number of the students educated at the Glasnevin Institution have done a great deal of good throughout Ireland.

2554. How many are educated there?—Over 2,000 have been educated altogether from the commencement; but all of those are not farming.

2555. How many years has it been established?—It came into existence in its present scale in 1856.

2556 That is 24 years at 6,000 *l.* a year?—It has cost more than that.

2557. Do you consider it has done a great deal of good by distributing scientific knowledge throughout the country?—It has.

2558. Has it done any good by making scientific discoveries for the benefit of agriculture in any particular direction?—Yes, I will instance one. I really think we have been the means of throwing some light on that very difficult question of contagious cattle diseases; and I think you will find, if you confer with those who have charge of that subject, that the institution has in that one particular direction possibly contributed in some measure to the carrying of the present Act.

2559. Do you refer mainly to Glasnevin?—I do.

2560. Excepting the discoveries made, or the information given to the public with regard to the cattle disease, is there any other matter regarding the cultivation of the soil, such as the growing of crops, that you think these institutions have given to the public?—I think the experiments that we have been making at Glasnevin, such experiments, for instance, as the one which I put the results of before the Committee on the last occasion, have been of immense use to the students educated there, and that those students have disseminated the knowledge throughout the country. I may mention to the Committee that we have experimented with all manures on all crops; though I am sorry to say that for several years there have been no reports published, that has been owing chiefly, I believe, to the desire of the Treasury to keep down expenses. In that way I consider our usefulness has been considerably lessened; but I do say to the Committee, that the knowledge acquired by experiments on crops of all kinds, and manures of all kinds, cannot fail to have been useful to the country.

2561. Then you would like to see the system extended, with regard to giving it greater publicity?—I should, certainly. I think the system is capable of great development.

2562. Will you give the Committee any suggestions which you think would strengthen and tend to improve the Government farms in Ireland?—It will be on my own responsibility.

2563. Will you state them to the Committee now generally?—Well, I think I had better say what is now a matter very well known, that in the time of the late Government some members of the Government proposed to detach the department altogether from the Board of National Education. It was suggested by some members of the Government themselves, and they consulted me about it, whether the public of Ireland would not be benefited more by detaching it from the Board of National Education and using the 6,000 *l.* spent upon it as the nucleus of an entirely independent department of agriculture. I stated to the Government that that was my opinion; and I was the more free to do it because I was retiring from it myself.

2564. Did you find much opposition to the present system on the part of the public?—No; on the contrary, I believe the public are much interested in it, and most anxious that it should be developed.

2565. Do you find that the public come and ask questions, and ask for information?—Yes. My own correspondence, I suppose, in one year came to nearly 5,000 letters in the year asking for information on all points.

2568. Is that increasing?—I am sorry to say, for my own comfort, the correspondence

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Mr. *Stewart*—continued.

asking for information is increasing very much indeed.

2567. You think if a further development took place by creating a separate department, and giving it further powers to report, and to put in force further experiments, that it would tend very much to improve agriculture in Ireland?—I do. I do not see any other means by which you can bring knowledge to the doors of the small farmers of Ireland.

2568. At what cost could that be done?—I think the immediate cost could be met very well if the department were created. My notion is, and has been for a long time; and I indicated that, in answer to a question put to me by the Chairman on the last occasion, that that 6,000*l.* a year, if expended as it should be expended, would bring into play every element of agricultural progress in the country. I believe you would get local aid from the gentry, if you addressed them in a proper spirit. One very remarkable instance of that occurred with regard to a suggestion I made lately to the County Cork Agricultural Society. The school there was about being abandoned, and, with the sanction of my employers, I applied to the local gentry of the south of Ireland for funds to develope the school, using the grant and not asking for any increased grant, and, up to the present moment, 300*l.* a year has been subscribed in the County Cork to this one school, and if all the views of the local gentry on which they and I agree are acted upon I believe a permanent sum of 500*l.* a year will be got from the local gentry to carry out the scheme in that one county.

2569. Then, do you think it would be advisable to confine your efforts in this direction to these model farms, or would you give prizes, as has been already suggested by several witnesses before the Committee?—That was my suggestion to the late Government, and they acted upon it. I repeat, and I wish not to be misunderstood at all, that I was the more free to do it, because I was retiring from it myself with the consent of the Government. I proposed an unpaid Commission, to have upon it two or three country gentleman; an eminent scientific man, like the President of the Queen's College, Cork, for one, an eminent agricultural authority, in relation to scientific matters; and to give that Commission adequate power and a good staff. They would give prizes, and expend the money very much as they thought fit. They would get the grant from Parliament; of course the Treasury would have to be consulted on the matter; but I say the grant once made, the hands of the department should be absolutely free.

2570. Of course 6,000*l.* would not go far in cultivating a large area of ground?—No; but I think that would be very well for the present The more you got no doubt the more good you could do. I have had a long experience of the Treasury, and it is not very easy to get an increased grant from them.

2571. What other farms are there besides Glasnevin; I believe that is about 180 acres in extent?—Yes, there is one at Cork 126 acres; a beautifully situated farm, with splendid offices upon it, fit for experiments of any kind. Then there is a very nice farm at Athy, in the county Kildare, on the estate of the Duke of Leinstor, of over 100 acres; but I am sorry to say the order is out for the abandonment of it.

2572. Are the reasons given for that abandonment?—I am not aware. Then there is another farm in Ulster, near Ballymonay, a small farm which, and I think is, doing good in the neighbourhood. We repeated there last year and the year before, the experiments I have been making at Glasnevin, and they created a wonderful amount of interest in the neighbourhood. Then there is a farm in the hands of trustees, which was attached to the department in Limerick, and I cannot help thinking that that is still available for any public purpose.

2573. Do you not think that the improvements effected by an increased knowledge of the science of agriculture would mainly benefit the larger farmers, and not the small cottiers?—Well, that is precisely why I should take very good care to make a distinction. I believe the existing Agricultural Societies in Ireland do good to the large farmers and the gentry, but that they are perfectly useless as far as regards the small farmers. Some few years ago I got a small grant from the then Lord Lieutenant of Ireland for the purpose of trying a totally different system. I got 60*l.* a year, and I applied to the gentry in the different localities for local aid, which I got, in some cases, very freely. I may mention to the Committee that, besides these large model farms, there is a considerable number of ordinary national schools throughout Ireland to which small pieces of land are attached, and that system is capable of being developed to a wonderful extent in Ireland, especially in the small farms district. I took eight of these schools as centres, and I used the schoolmaster, who is a bit of a farmer, as the local agent. I selected four Liberal and four Conservative proprietors, and I took two in each province. We commenced with about 10*l.* for prizes in each of these districts. That went on for five years.

2574. Did you limit those prizes to a limited area?—A limited area; say three miles radius about the schools.

2575. And a limited rental?—We did not give anything to anybody with a rental which exceeded 8*l.* a-year; I can state to the Committee, as a positive fact, that the result of that was simply marvellous; a very large landed proprietor, Colonel King Harman, who takes a very active interest in the improvement of his tenantry, wrote to me for information with regard to this system, and I happened to be going down for a day or two to the Longhglynn estate of Lord Dillon's to inspect and judge for the prizes there, and I wrote back to Colonel King Harman that he had better come and judge for himself; he did come with me from house to house in one of the poorest parts of all Ireland, and he said if he could get official inspection he would spend any reasonable amount of money in carrying it out; the results were to him, who knew the district so very well, very remarkable, and I do submit to this Committee, as the question has been raised, that that is the only way, as far as diffusing agricultural knowledge goes, of reaching the mass

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mass of the Irish small farmers; I have made a report of the result of those experiments, which I shall be glad to furnish the Committee with.

2576. Do you not think that the same advantages could be obtained through the local agencies of local agricultural societies?—My notion was, as you will find from my report, that I should really establish a small society in every place where I should have my prize system.

2577. Would you establish that in conjunction with these farms, or a central association?—Locally, if I could, certainly.

2578. But supposing there was not money to do so, do you think that any pressure could be put upon local societies to establish such a system as you propose?—I think myself there could not be a better application of the public taxes than in the way I have indicated; you might have a small rate, very small indeed, and work it through the poor law and spend it in the district for the benefit of the people; I think we are too much in the habit in Ireland of appealing to the Treasury on all possible occasions, and neglecting to call into play local enterprise, and local elements of enterprise; with a grant of public money, and a proper staff of Government officials, I should look to the likelihood of doing good by calling into play fuller elements of progress in the country than by squandering public money wholesale.

2579. You would not be afraid of strangling local energy by passing them in connection with a central authority?—I should endeavour to carry out precisely what we are doing at Cork now. The department is perfectly free in the administration of the public funds; then the local body comes in and supplies money to found scholarships, and to furnish additional educational plant and appliances. If a country gentleman wants to educate his steward, or a farmer's son, I do submit to the Committee he ought, in the first place, to put his hand in his pocket and contribute towards it, and that is an illustration of what I mean by calling into play local enterprise.

2580. Would you propose to give a subvention to any such local fund?—I should be disposed to say sufficient to supply the plant, and supply the staff. You have the Government farms, and the buildings on them.

2581. You could not supply a farm in every county for 6,000*l.* a year?—I do not think you would require it in every county. The large farms would be for experiments for the benefit of agricultural science generally.

2582. The large farmers, you think, can take care of themselves?—I do. With the Government department, I propose we should have a staff of inspectors, and wherever a country gentleman, or an agricultural society, would supply the funds to give the prizes, we would supply the inspectors. I think there is a great difficulty in Ireland on that account. I am asked to go every year and act as judge of farms for county societies, and over and over again I have had to refuse such a society as the County Carlow Society. I think if an independent officer were to go down there, conversant with the business of farming, and having no local knowledge of the competitors, that his decision would be received with much more confidence than the decision of any local man.

Mr. *Stewart*—continued.

2583. Your suggestions, as I understand them, would rather leave out, in a great measure, the larger farmer, always supposing that they are mainly cared for by the large agricultural societies?—And by these large Government farms, on which I would make experiments for their benefit.

2584. Your suggestions would mainly go to assisting the development of agriculture amongst the small cottier farmers up, say, to a rental of 10*l.* a year?—I mean both. The large farmer in Ireland does not require, according to my knowledge, any special, shall I call it, nursing, more than the large farmer in England or Scotland. On the experimental farms I refer to, experiments might be made in dairy business; experiments in manure; and experiments in feeding; and reports might be published, and the large farmer would benefit from them, because he is a reading man, and would see the results. You cannot expect the little farmer to take the same interest in experimental work, and, therefore, it is that I would go specially to his door

2585. Do you consider that the suggestions you have made would lead more than anything else to diminish the extent of the potato disease, and to improve that particular article of agriculture and commerce?—I have no doubt in the world that by continuing the experiments we have been carrying out, and which others are carrying out now, you would greatly lessen the ravages of the potato disease. I am quite clear on that point.

2586. That, and the stamping out process, you have already suggested to the Committee, would be your two main principles?—Yes; with regard to the potato disease, if I did not make myself intelligible on the last occasion, I should like to do so now. I should proceed by steps. First of all I should continue the experiments with a view of bringing out new and improved varieties, and making experiments on the best manure, by which I believed I might strengthen the plant largely to resist disease. If there was this new Department of Agriculture, I should entrust it with a searching inquiry into the whole nature of the disease, and to see whether I was right in my view with regard to the stamping out, and also with regard to new varieties. If my views with regard to the possibilities of stamping out be feasible, there might be legislation afterwards.

2587. Then you would extend the present system of Government farms in the way you have been describing to the Committee, so as to take in the whole country?—I should, certainly.

Mr. *Macdonald.*

2588. Hitherto your farm has been more of an educational character, as I gather from your remarks, than experimental?—I do not suppose that experimental work ever entered into the heads of those who started it. They found agriculture in a low condition, and they thought evidently that education would be a good thing; but having the machinery, the plant, the soil, and

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and the buildings, it soon occurred to me to utilise it in the double way.

2589. The original object of the formation of the farm or the founding of the institution was to educate young men rather to take part in the farming of the country; is that so?—That was so.

2590. So that there was no such object as finding out the best adapted lands in the country for growing potatoes, or anything of that kind?—No, that was never contemplated.

2591. Would you think such an establishment as you suggest, under the Board of Agriculture, highly desirable; that is to say, not only should the grower produce new tubers, but also select or examine spots best calculated for the cultivation of the varieties of potato that we have at present?—I think the greater number of farms, and the greater the variety of soils that you operate upon in any experimental work, the better; you have a wider range of observation, and, speaking from experience in making experiments, you very often find that what will occur on one farm will contradict what, in point of fact, may occur on another, and therefore, I say, the greater the variety of experimental farms you have the better; but in the present temper of the Treasury I should almost be disposed to say there would be a great difficulty in getting a larger number of farms established. I think if the Board of Agriculture were properly constituted it would command so much of the confidence of the gentry, amongst whom there is a great deal, I am happy to say, of public spirit, that they would come forward and volunteer to give a field or a piece of land to try these new varieties upon. I can state that from personal observation. I find that at the present moment the gentry of Ireland are most anxious that something should be done in the direction I indicate, and I am quite sure you could call into play so much local enterprise and local public spirit as would relieve the public exchequer very much in the direction you are now indicating.

2592. Now, supposing we had half a dozen persons capable of thoroughly examining into the soil best calculated to promote the growth and healthy cultivation of the tuber so far free from disease as possible, do you think it would be a desirable thing that those persons should visit the various parts of Ireland, or of Scotland, or England, and see the soil best adapted for that purpose?—I should, certainly.

2593. Would you not think that would be a highly desirable thing?—I do. The wider the range of observation, the more you strengthen a man's mind to work out any particular view.

2594. You say you have had 2,000 young men educated?—Yes, altogether.

2595. Supposing that you had these 2,000 young men, or 1,000 of them, who had gone to farming, and they were to render you reports from the various districts that they were located in, giving you an account of the condition of the growth of the tuber, and so on, whether healthy or otherwise, would such a state of things tend vastly to improve the present knowledge of the cultivation of the potato as a plant?—There can be no doubt at all about it, and you have in Ireland a considerable number of most intelligent landed gentry; a very considerable number of those young men to whom I have referred, and others, who would most willingly co-operate in the way you point out, in furthering the production of good varieties, and in devising means to prevent the disease.

2596. I think you said, on the last occasion, that the loss of the potato crop was something like 8,000,000 *l.* in Ireland alone, in 1879?—Yes.

2597. Do you know what the supposed loss was in 1878, because there was a loss in 1878 as well?—It would be fully half that.

2598. And in 1877?—Well every year, I should say, for the last three years; 1877, 1878, and 1879, were bad years; I should think it would be a very moderate estimate to say that in the last four years the loss has fully come to 20,000,000 *l.*, and I believe that is under the mark.

2599. Now supposing we had had this state of things for 25 years that I have indicated, to wit, gentlemen going into various districts pointing out the desirability of the culture of a certain class of potato and the superiority of the ground for that purpose, do you think that we should be having this terrible loss that you have referred to in the last few years?—No, you would have done what I think is quite possible without resorting to the stamping out process at all; you would have reduced the loss very considerably, you would have minimised it.

2600. So that the effect of the violence of the seasons, or of the severity of the seasons, would have been minimised upon the crop by careful watching like that?—Most decidedly.

2601. Would the value of such services on the farm more than be recouped by the preservation of the crop?—The saving would be incomparably larger than any outlay that would be made upon it; the outlay to produce the result would be utterly insignificant compared with the great saving to the nation.

2602. Then, may I ask you, do you not think it is a scandal that we should, after 25 years knowledge of this terrible enemy to the potato, be in the position that in one year there was a loss of 8,000,000 *l.* in one country alone?—I think it is really a scandal; it is a strong word to use, but I really think it is.

2603. Do you think that private enterprise will ever reach the correction, or ever the minimising of the evils of the seasons?—I do not think that private enterprise will ever cope with the difficulty; it has utterly failed to do it.

2604. Then you are not afflicted with those politico-economic notions, that you should leave everything to private enterprise?—No; I am sorry to say that the disgraceful state of things to which you refer, and my opinion is formed after knowing a great deal of them, is entirely owing to the fact that a number of doctrinaires have been allowed too much influence in guiding the minds of the governing classes.

2605. Doctrinaires, and not practical men?—Yes.

2606. You would really establish, through the medium of the Government or otherwise, a system that would attack the disease generally, rather than

Mr. *Macdonald*—continued.

than leave it to private enterprise?—Certainly; I should like to add that they are doing it actually in France; look what France has done with the vine disease; look what Germany is doing with its experimental stations; it is doing what I am now proposing to do, and what I have been for years proposing to do, namely, to try and bring the Government into harmony with the landed interests of the country.

2607. Do you know anything of Belgium?—I do. I am very well accquainted with Belgium. In America, every State has given a large grant of land to endow a State Agricultural College, and for some years in India there has been a Department of Agriculture, which has made several reports, and has rendered useful service.

2608. Are you aware that in every State in the United States they publish annually an agricultural report?—Yes, they do.

2609. Then, in addition to the State reports, a number of them publish triennial reports; have you seen those?—Yes.

2610. Then, further, there is a general agricultural report by the Central Government under the superintendence of Professor Baird?—Yes.

2611. All these methods which, in France, Belgium, Germany, and America, are applied to other diseases, you think it would be desirable to have in England as well?—I do. I take, as an illustration of that, the frightful losses which the landed interest in England (I mean by that the gentry and the farmers) suffered from the contagious cattle disease. You cannot have a better illustration than that.

2612. Have you seen those highly illustrated works published by the Central Government of the United States on the Colorado beetle?—I have.

2613. And also with regard to other diseases that were attacking plants?—Yes, there are men specially told off for that purpose. There is a very complete organisation in America.

2614. Are you aware that they have sent people to Europe to make inquiries into those subjects?—I am quite aware of that; and the Government of Canada have also done that.

2615. We are really on the ground of private enterprise, and in consequence of doctrinaire opinions behind the world in collecting information for the guidance of our people in agricultural matters?—Yes; and I should like to add, what I am quite sure most men will agree with, that our improvements in agriculture have been forced and pressed on by the accumulation of wealth rather than by the force of knowledge; and that if we are to hold our own at all, the only chance for us really is by education in the widest sense, including the sort of education which you are now referring to.

2616. And in the matter of the improvements in agricultural implements, they have been forced on us by the action of other countries, so far as America is concerned?—A good deal; but there may be an exception with regard to the agricultural implement trade. That has reached a high pitch indeed, stimulated by the demand.

Mr. *Arthur Moore.*

2617. You spoke last time about the possibility of picking upon an island, and of stamping out the disease entirely; now suppose that was to be adopted, are you aware of any part of the world where perfectly sound healthy seed could be got from?—On a question of that kind, amongst scientific men, as you have no doubt found already, there is a considerable conflict of opinion. I have a correspondence with America, I have also a correspondence with India; and all my correspondents in India do not know the potato disease.

2618. So that you believe there are potatoes to be found in some parts of the world perfectly free from disease?—I do; I got three successive lots of potatoes from America, and I grew them in the way I explained the other day, and not a speck of disease appeared upon them.

2619. You have perhaps heard a good deal about resting spores; do you believe much in the resting spore theory; that is to say, that the germs of the disease remain in the land from year to year?—All we know upon that subject rests entirely on the testimony of Mr. Worthington Smith.

2620. That testimony is extremely strong?—It is very strong; I never met him until I met him in this room, but I have read all he has written, and I am bound to say I am very much impressed with what appeared to me to be the conscientious care with which he worked; but at the same time I think further research is necessary.

2621. Did you see that he went so far at the end of his evidence as to say he had taken these spores out of the land himself and submitted them to the microscope?—I read that in the evidence.

2622. Is it true or not true that in many parts of the country great value is set upon having the first crop of potatoes out of meadow land or grass land that has not been broken for many years?—Yes. it gives the best crop.

2623. Is that a strong confirmation of Mr. Worthington Smith's opinion?—I think not.

2624. Why not?—For this reason, that assuming for argument sake they were found out after the third year, and he says they will not live longer than three years, that is the limit; they could not remain in the grass land for 20 years.

2625. I think you misapprehend what I have asked you; if Mr. Worthington Smith is right in saying that resting spores are the cause of the dissemination of the disease is not strong confirmation of that opinion that you find, as I think you are prepared to admit, the first crop of potatoes taken out of grass land that is broken particularly healthy?—I explained that to you on the last occasion, and I should like to add what I consider to be of great importance in connection with the whole question, that grass land gives a better crop of potatoes, simply because the grass has been taking out of the ground only the constituents that the grass requires, and nothing more; and that it makes very little demand on the land for the constituents that the potato requires.

2626. You are referring to the question of potash I suppose?—Yes, and phosphates.

2627. Now I want to ask you a few questions about the mode of raising with regard to lazy beds

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beds and drills; perhaps you will give the Committee some idea as to which mode you perfer?—In Ireland there is so much wet, undrained, cold, clay, ground and undrained and unimproved bog, that I have no hesitation at all in saying it would be a great folly to attempt to grow potatoes in drills in that wet land; and then again, the tillage of Ireland has been so imperfect that the lazy-bed system gives a certain amount of drainage to the ground which I consider to be most beneficial in a country like Ireland.

2628. Then with regard to the manures which you think potatoes ought to have; I suppose they ought to have such manures as would supply the plant with the necessary plant food?—Yes, decidedly.

2629. Will you give the Committee some idea about that?—I think in that little tract which I referred to the other other day, I stated that the mixture of super-phosphate of lime in the proportion of 12 cwt. of super-phosphate to 8 cwt. of kainit, would, for the land in the hands of the small farmers, make a good mixture. I should be very much disposed to say that for a large farmer who wanted an artificial manure for potato, a good mixture would be super-phosphate, kainit, and some sulphate of ammonia, in the proportions of 10 cwt. of super-phosphate, 7 cwt. of kainit, and 3 cwt. of sulphate of ammonia, varying it perhaps according to the quality of the soil, as it wanted more or less potash.

2630. I suppose it ought to be supplied with a certain amount of nitrogen?—Yes; that you get in the sulphate of ammonia.

2631. What do you think is the best mode of storing potatoes?—The best mode of all would be of course to put them in a house, but that is impracticable. The most practicable way of storing potatoes is in small, very narrow pits; the smaller the heap the better, and as I said to the Committee, I find the best material to cover them with would be stubbles. You cannot always have stubbles enough for the purpose, but where you have it is the very best material. It is porous, and keeps them thoroughly dry.

2632. Those pits should be 12 inches deep below the surface?—Yes, on dry ground, but not in wet land.

2633. And rising to two or three feet deep of potatoes?—Not more than three feet.

2834. What do you think is the best place which potatoes could occupy in the rotation of crops?—The best crop I find in practice is that which is raised after old fresh lea ground. They should not be introduced more than once certainly in six years if possible. The longer they are apart in the rotation the better.

2635. Have you a strong opinion as regards whether the potatoes ought to be sown in setts or planted whole?—I think it is a waste of seed to sow large whole potatoes. I find that the best result, all things considered, is got in parts where you get sound seed, not the very large ones, and not the small ones by any means; and cut them into "setts," leaving two eyes in every sett. When I have planted the whole potato, I have found there are too many tubers, and unless the ground is very richly manured, they do not grow fully, there are so many of them.

2636. Do you attach much importance to getting seed from late or early districts?—There is a difference between the potato and most other crops in that respect, and I consider it is owing to its being propagated from the tuber. I find that in changing seed corn, a great advantage is obtained by bringing it from a warmer district; but I have found in the potato that it is really better to bring it from a district a little later than your own. If I were raising potatoes from seed, I should not adopt that rule, but I should be very much disposed to go to a district a little earlier than my own.

Mr. *Arthur Moore*—continued.

2637. It has been said that you cannot alter the habits of the potato and make it earlier; do you share that opinion?—I am very much astonished to find that that statement was made. I think there is one fact which is very well known. It is not an original observation of my own at all, but it is important as bearing on that point. If you take setts from what is called the rose end of a potato, that is the upper end, and setts from the root end, that is where it is attached to the stem, you will find if you plant them at the same time that the setts from the rose end will come to maturity a fortnight earlier than those lower down, so that in reality you can make a late variety early, and *vice versâ*.

2638. That is to say, by using the upper or lower setts?—Quite so; and I have done it myself. I have cut a quantity of potato setts from the rose end put them in one basket, and setts from the lower end, or the root end, in another basket, and planted them separately, and I have found a difference of a fortnight in their arriving at maturity.

2639. Have you observed the evidence of Dr. Voelcker that potash was of no more use to the potato than to other crops?—I did; but I dot not think Dr. Voelcker meant to convey all that his words might seem to convey.

2640. Why not?—In the first place, because there is a larger amount of potash, acre by acre, in the potato than in any other crop.

2641. And that makes potash so especially necessary for potatoes?—I consider the presence of potash in the soil is a necessary condition for the growth of a sound crop.

2642. And the growth of potatoes is a heavy drain of potash from the soil?—It is.

2643. On the last occasion you said that in Connemara they supplied their potash on the coast; is the result that they get good potatoes on the sea coast of Connemara?—They do not select the seed, but it is wonderful what good crops they grow. I will mention a curious fact to you with regard to that question. There is one part of the county Dublin where sea sand and seaweed are largely used, and I have never seen a speck of disease there.

Mr. *Earp*.

2644. In any seed?—In any seed. I am merely stating that when my own crop was diseased I found the potatoes there perfectly free; that is, able to resist the disease at the time I visited there. I do not mean to say that they were capable absolutely of resisting the disease, but what I mean to convey to the Committee is this, that if you supply the crop with proper nourishment, and till the ground properly, you

Mr. *Earp*—continued.

you do strengthen the crop so that they will resist disease.

Mr. *Arthur Moore.*

2645. You are familiar with parts of the country where it is not the habit of people to break any more of the ancient pasture than they can possibly help, and the result is, that in many cases gentlemen, but invariably the labourers, perhaps, have no chance of obtaining anything but a half or a quarter of an acre every year, and they have to get potatoes, whether good or bad, out of that every year. What would you suggest could he done to try and eliminate disease out of land more or less diseased, and where there is no practical possibility of getting a change of soil?—In that case there is nothing for it but two things: one is selection of good seed, and the other is to give plenty of artificial manure with such home-made manure as they have; such artificial manure as I have just mentioned, the three constituent of, with less nitrogen, because there is a good deal of nitrogen in the manure they have, such as it is.

2646. Now, Dr. Voelcker spoke of the time of year for putting on manure. What time of year do you think this potash ought to be added?—I think the best time is in the spring. He appears to think it is the autumn. I think if he had experimented more largely he would have found that he need not be afraid of its being washed out of tho ground in the spring.

2647. It has been represented by some of the witnesses, Mr. Worthington Smith, and others, that the manure by being put on in the autumn became better assimilated with the land. Do you think that is the case?—I think it is likely to be more assimilated; but I should be very much inclined to say if you put manure on your land in the autumn there is great danger that a very considerable quantity, and that the most valuable part, may he washed out by the heavy rains of winter.

2648. Mr. Shuter the other day here spoke of a method which had been adopted by a friend of his, a farmer in Kent; he had gone year after year and selected always the finest plants of a given variety, selecting the very best that were produced; what should you think about that; do you think it is very important, if you wish to preserve the quality of the seed and to prevent it deteriorating, to act in that way?—I do; but I should not rely merely on the stalks, I should take the whole plant, stalk and tubers.

2649. When your attention is attracted to a well grown stalk you would examine the tubers, and if satisfactory you would put it aside if you wished to keep the seed in its perfection?—I should; and in connection with that may I mention a curious experiment I made, and which I am sorry to say I did not repeat for want of time. I took the specific gravity of potatoes at one time, and I found that hy growing from the dense kind, on the principle of selection, I got a denser kind. I throw that out for the consideration of others. I only made the experiment once, and it certainly proved to me to be very encouraging, and I should like somebody else to follow it up.

2650. Mr. Carruthers' evidence did not quite go in the same direction; he seemed to think there was not quite so much good in picking good

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seed?—Well, I cannot for the life of me see how anybody can come to the conclusion that there is no good in picking good seed.

2651. Have you anything to say about the difference in growing from seed and from tubers?—The only thing I have to say on that point is this: When you grow from the tuber, and get the variety fairly started, they are very true to kind; but when you grow from seed it is very remarkable that from the apples you get a great variety. There is an extraordinary tendency in that way, and the result is absolutely uncertain.

2652. Have you ever found the ravages of the disease vary with the constitution of tho plant?—I have invariably found that. With regard to the question of the difference between seed and setts, which you have put a question to me upon, I think this is material. The principle of selection applies to the sett thus far, that you are very liable, if you try the same treatment, to have the same sort repeated, but if you want a really fresh genuine start in a new kind you must go to the seed, and, above all, you must hybridise.

2653. Are you very strongly in favour of burning the stocks?—Well, I am in favour of it.

2654. You think that is a matter of great importance; do you think the disease is much propagated by means of the stalks of diseased potatoes?—I do not. I think the extent to which it is propagated in that way is greatly exaggerated, but I am quite certain it is capable of being propagated. I believe the tuber itself is the great means hy which the disease is propagated.

Mr. *Colman.*

2655. Do I understand you to say that sea sand was added to the soil in county Dublin?—Sea sand that contains a little phospate of lime is used in several places. In many parts we have that kind of sand. Take Youghal, in the county Cork, and other parts of Ireland, there is a considerable quantity of this sea sand, which is supposed to be merely sand, but in reality its efficacy turns upon the presence in it of a sensible quantity of phospate of lime. That is not the case in ordinary sea sand.

2656. With regard to manure, you said you thought it would wash away if applied too early; was that the result of experiment or of inference?—The result of experience, and not experiment or inference. There is a notion amongst scientific men, more especially since some researches which were made by Professor Way of this city, and most able and searching experiments they were, on the absorbing powers of the soil, which I shared till I was compelled to modify my views by large experience, that all the constituents of the manure are capable of being absorbed and fixed in the soil. I believe that is to a great extent true, but when you put soluble salts on the land, say in the autumn or winter, and there are heavy falls of rain, I believe that there is great danger that they may be carried away in the crevices of the soil before the soil has time to come in contact with it.

2657. Do you mean that the farmyard manure will be better applied at one time and the artificial manure at another time?—That would be different from artificial manure; I have experimented

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experimented with that. I have put it as a top dressing on the land in autumn, and the quantity of soluble matter in farmyard manure at one time is so small, that I believe in that case the soil has got the power of absorbing all that would come down at any time by any shower, and as the decomposition sets in a little more is liberated, and the soil would absorb and fix that too; but when you put on a soluble salt in the autumn and a heavy shower of rain comes, a thunderstorm for instance, I have found from experience that the crop is not so good. So far, it is a matter of inference that the soluble salt is not capable of being absorbed and retained by the soil.

Mr. *Macartney.*

2658. I understood you to say that in your opinion the establishment of Government farms has been beneficial in Ireland?—In the past they have done some good, but not so much as might have been.

2659. You are acquainted with the Ulster Model Farm at Belfast?—I am.

2660. Was that a success?—In the first place I will answer that question by saying that it educated a number of very clever young fellows, who got a good knowledge of the principles of agriculture, and they have been dispersed throughout Ireland, and so far it has done good. The soil was a particularly cold stiff soil. I think, as I have always thought, if they had had proper machinery in Ireland, and a proper Government Department, that that school could have been made one of the most useful in Ireland. The soil is a difficult one to manage, and it is typical of a large range of soil in the county of Antrim; and I think that experiments could and ought to have been made there that would have been of great use to Antrim.

2661. Was not that particular soil selected expressly for the purpose of making experiments, because it was a soil that was typical of Antrim?—I do not think so; I have reason to think not. It was selected by the late Dr. Denver, and that was a consideration that never entered into his head.

2662. Was not that institution used almost as much for educating young men at the model school in Belfast as for educating them for agricultural purposes, or rather more so?—For reasons that the Committee will appreciate, I am very unwilling to enter upon that subject, inasmuch as I have been connected with it. That was one of the causes of failure. It never was an agricultural school, pure and simple.

2663. The pupils were never employed in the work on the farm, but labourers were employed?—Yes, and I say the experiments did not get a fair trial.

2664. I understood you also to say that in your opinion Government might give prizes or help to give prizes, which were to be awarded according to the decision of Government inspectors?—My suggestion was that the State should merely provide the inspection, and that the funds for the prizes should come from the local gentry, and those anxious to promote agricultural progress.

2665. You also stated that in your opinion the boards of guardians ought to levy rates for the purpose of providing these prizes?—I do not see a more useful application of the fund.

Mr. *Macartney*—continued.

2666. Is it your opinion from your experience of the boards of guardians in Ireland, that they would be easily induced to do this?—When I answer a question of that kind, I answer it on the merits. My experience of boards of guardians is, that it is very difficult to get money out of them, and why should it not be. It is the same with other people. They are human nature like boards of guardians elsewhere.

2667. The motive in this case would be the improvement of agriculture in their neighbourhood?—It would.

2668. Was their action in the improvement of education where they had to pay the rates to assist the Government with regard to the result fees encouraging as to what their action would be in providing money towards agricultural purposes?—As far as that goes their action has not been encouraging, but in what I have been suggesting in answer to the questions put to me, I should really not leave it optional with them, I would pass a short Act of Parliament, and levy the rates, and use the money.

2669. You would make it imperative, and not optional?—Certainly; the same as it is made imperative upon them to a certain extent to support the poor. I merely refer to the board of guardians as a means of getting funds for the prizes.

2670 Then those prizes would be distributed by the board of guardians under the direction of Government officers?—The Government would supply the staff. I may mention to you what my opinion upon that point that you have been putting to me is. A very large number of persons in the county of Cork, gentry and large farmers, in connection with the revival or reconstruction of the school, there have actually volunteered to me to move in the direction of bringing in a Bill for taxing themselves for supporting the school.

2671. Those are the upper classes?—No, they are mixed; there are farmers amongst them.

2672. The large farmers?—Intelligent farmers.

2673. Are they small farmers?—Not the very small farmers.

2674. I understood you to say, just now, that the large farmers should be left to themselves; that they were sufficiently independent and intelligent, as the farmers in England and Scotland were, to be left to themselves, and that it was for the encouragement of small farmers you would suggest these prizes?—Certainly; I do not see any reason why the agricultural societies should not give prizes for the best managed farms if they think fit.

2675. They do that at present?—To a limited extent.

2676. Are there not prizes given in a great number of districts in Ireland for the best green crops which are selected by gentlemen connected with the Royal Agricultural Society and the Dublin Society?—I believe that system to be thoroughly unsound. It is putting a premium on one particular crop. I say, if a prize is to be given at all, it ought to be given to the farm all round, that is taking everything into account, and that the system adopted by many agricultural societies of giving prizes for this, that, and the other crop appears to me very much like the old system of bounty. I will add that, in your own agricultural

Mr. *Macartney*—continued.

tural society, in which you are a member of the council, the matter was proposed by Mr. Townsend, and although he is a very able man and an influential man, I need not remind you that the thing fell through.

2677. Your proposal would be to give these prizes for crops all round; not for potato crops alone?—I should say prizes for the best managed farms. I should encourage the production of new varieties of potatoes in a different way.

2678. I understand that your recommendation is for general farming purposes, and that prizes should be given separately for the encouragement of new species of potatoes?—Quite so.

2679. In answering questions about the communication of the properties of manure to land, you stated that the washing down of farmyard manure into the land by successive showers, sent the different portions into the ground, and that then most of them are absorbed?—Yes.

2680. But is it not the experience of farmers that where heaps of farmyard manure are left out in the rain during the winter, the manure is very much deteriorated where it is not left under cover?—I do not approve of allowing manure to remain uncovered on the land, but as you happen to put the question to me I may say this, that it is a very curious thing that Dr. Voelcker has actually written a paper in the Journal of the Royal Agricultural Society of England, the tendency of which is rather to encourage the spreading of farmyard manure on the surface.

2681. I mean where they leave heaps of manure lying together before it is spread; is it not the practice of the best agriculturists to keep them under sheds to prevent the rain injuring the manure?—Certainly, but the question put to me had reference to the mode of applying it.

2682. Then the action of the rain is not as deleterious, after the manure is spread in small quantities on the ground, as it is when lying in heaps together?—No, certainly not. It is very much injured when it is in small farmyards in small heaps; greatly deteriorated by the rain.

2683. Do you believe that if this system of giving prizes, either separately by the boards of guardians or jointly between the boards of guardians and the agricultural societies in different parts of Ireland could be carried out, that the small farmers would take advantage of it?—I do, and I will add that there has been no attempt yet, that I am aware of, on the part of any agricultural society, or on the part of the Government itself, really to dig down into the minds of the small farmers, except that experiment which I carried out under the auspices of Lord Spencer for five years, of going to their doors making a sort of mission on them. That is the first time that their minds were really reached.

2684. Of course you are acquainted with the different farming societies in Ireland. There are several large ones, and a great number of local societies which have not a great area to exercise their functions upon. Do the small farmers take any interest in those societies at present?—No, certainly not.

2685. Is it not their interest to do so?—That raises a totally different question, and a deeper question. They think, whether rightly or wrongly, that the agricultural societies of Ireland are merely instruments got up by the landlords to show the capabilities of the land, and that the motive of the landlords in organising and maintaining these agricultural societies is not to benefit them. It does not matter whether they are right or wrong. I say myself frankly, that they are doing the dog in the manger, but I tell you now, and I tell this Committee, that the feeling is there deeply seated in their minds.

2688. There are societies in different parts of Ireland which have been established especially for the benefit of very small farmers and cottagers for the purpose of inducing them to grow vegetables of different kinds, and encouraged by the Cottage Gardening Society in England, I do not know whether you know much about them, where they have been established?—I do.

2687. Have they stood still, or have they gone back?—I paid a good deal of attention to those societies, and, as possibly you are aware, I took part in the proceedings of one of them on your family estate, and I am bound to say that the efforts in that particular direction of your family were eminently successful, not perhaps as successful as they might wish, but I can state that good was done, and I am quite sure that if that system were extended, and if you could calm the public mind so as to direct the minds of the public to industrial employment, and to see the advantages of cultivating in themselves habits of skill, industry, and thrift, that they would be immensely more useful than they have been.

2688. Where they have been established, have they continued unless they have been very much stimulated by persons above them who took a very great interest in them?—No, certainly not.

Sir *Hervey Bruce.*

2689. I have heard remarks made at some of these societies that it was wrong for them to show such good vegetables, because it would make their landlords think that their ground was too good; do you allude to that sort of feeling?—I do.

2690. At my own local society the observation was made by several of the people who were growing crops round about?—What I say to you and to the Committee is, that the feeling is deeply rooted in the minds of the people; whether it is right or wrong I do not here offer any opinion, and this is not the Committee before which to discuss it; but it is there all the same, and I go as far as to say to you that they are doing the dog in the manger. They will not take a pound out of the ground because the landlord may get a shilling. I deplore it, but the feeling is there, and it is very unfortunate.

2691. You have talked about the goodness of the manure being washed out if rain fell rapidly. How long do you think the advantages of lime remain in the ground afterwards?—That varies very much with the quality of the ground; if you take stiff clay ground, such as you have in Ulster, and drain it, and then, a year or two after you lime it, I believe the effect of the lime will last, in round numbers, a dozen years. In lighter lands, such as we have in the midland counties, I think it begins to lose its effect from five years and upwards.

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Sir *Hervey Bruce*—continued.

2692. As to the sand, do you think there is any advantage in putting pure sea sand, that has nothing soluble in it, on stiff clay land?—I do.

2893. It is very much practised in my part of the world?—Yes, and I believe it is still more beneficial in bog land; even the pure sand.

Mr. *Storer.*

2694. I suppose your experience is not confined to Ireland?—No.

2695. Do you think that in England anything of the kind would be beneficial also in the interests of small farmers. I am not aware that there are any experiments or schools being carried on?—I must answer the question by saying that what is good for Ireland ought to be good for England, and I think there are many districts in England where small farmers do not farm well.

2696. At present there is no machinery of that kind?—No.

2697. Do you think a Minister of Agriculture would be useful in superintending and organising these sort of institutions?—I think it would be eminently useful in England.

Chairman.

2698. You said that sea sand contained phosphate of lime?—That is what is called the coral sand.

2699. Do you mean sea sand made up of broken shells?—Yes; all the coral sand contains phosphate of lime.

2700. There is some on the Connemara coast that is absolutely without phosphate of lime?—Yes.

2701. But it is a distinct variety that contains the phosphate of lime?—Wherever you find shells there is a trace, more or less, and in these parts of Ireland where no phosphate of lime has been recognised at all, even that small quantity acts beneficially.

2702. Could you tell us how the Government acted in France in stamping out the vine disease?—They offered prizes and encouraged research, and so did the agricultural societies.

2703. There was a theory propounded here by a very large salesman who seemed to be well acquainted with the subject, that varieties of potatoes which produce abortive flowers were less liable to degenerate than those which produce, and he instanced the Regents' flowers. Have you ever heard that theory before?—Theoretically much may be said for that, and after all it is a question of science. If it be a fact, that fact must admit of explanation. I have seen the observation before; it has not, therefore, come before me for the first time. The great effort of the plant is the production of the seed, and in the production even of the small quantity that is produced in an ordinary fertile potato there is a considerable expenditure of the plant, and in the economy of an unfertile plant that is saved, I have no doubt in the world, other things being equal, it will be stronger. There is not the slightest doubt in my mind upon that.

2704. You have no reason for supposing that a potato plant which produces abortive flowers would be exempt from the degeneracy which we are told overtakes the potato plants generally?—No, anything that I say is entirely speculative. I have no experience, and if I were merely to refer to the experience of that gentleman I should say certainly the facts were rather against him, because the Regent has shown great signs of weakness of late.

Chairman—continued.

2705. Several of the scientific witnesses were very anxious that we should have an early kind of potato, so as to anticipate the disease and have the crop stored before the disease is usually developed. Do you believe that that is feasible?—I do, if you do not force the crop too much. In the garden, for instance, you will get a crop that will almost store and be good for use all the year round. Take the Flounder. At Glasnevin we grow the Flounder in the garden, not as a very early kind, because it is not a very early kind. As already stated, Myatt's Prolific is the one we find to be the best in the garden for early purposes. The Flounder comes in after that, and when you do not grow it very early, and treat it well, we find it will bear storage all the year round. Then to come to the Field, I find the same thing. I find the strong growing early kinds are capable of resisting disease better than the late ones, and therefore I go in thoroughly with that observation so far as to recommend the propagation of early kinds.

2706. Mr. Shuter, a very large salesman, stated positively that there was no early potato that would keep, and in fact that it was impossible to establish a variety of potato that would do the general work of the potato, and that would keep during the spring and the following summer?—I think his deduction has been too sweeping, and that is the extent I should like to go.

2707. Do you know of any early potato that will not germinate, and will bear storage all the year round?—The Rough Scotch Kemp is a good kind to instance. It is an early kind, and I know that we stored it all the year round. As I tell you, even the Flounder grows in the garden, and Mr. Gray, the gardener at Glasnevin, who is a man of considerable power of observation, and a man of large experience, takes that view of it too. He believes the Flounder can be grown so as to store all the year round.

2708. I will ask you now to be good enough to give us in a paper showing us the expense and the general method of manuring and working an acre of potatoes at your farm at Glasnevin, showing the details from beginning to end, including the expenses and the distances apart, so that there shall be appended to our report a practical plan for growing potatoes which might be followed?—It is as follows: I may premise that the crop varies with a good many circumstances. Even on the same farm the cost of applying manure will vary from year to year, according to the distance of the field in which the crop is raised from the steading. Again, the cost of ploughing varies with the quality of the ground, Sometimes, too, we employ three horses in autumn ploughing in preparation for the crop. I

give

Chairman—continued.

give the average as closely as I can, assuming the crop is raised in drills:—

	£.	s.	d.
Ploughing in autumn	–	13	6
The preparatory cultivation in spring varies with the seasons; I put it at	–	15	–
Manure: 20 tons farmyard manure, at 5 *s.*	5	–	–
Kanitt	–	18	–
Application of farmyard manure	–	16	–
Ditto of kanitt	–	1	–
Seed, and cutting and planting, say	4	10	–
Closing drills	–	3	–
After cultivation, about	1	–	–
Digging, with the aid of a suitable plough, and pitting	–	17	6
	£. 14	14	–

The drills are made, on an average, about 30 inches. When planted on lea the ground is deeply ploughed in winter or early spring, the grass being completely buried by a skin coulter on the plough, or by a one-horse plough preceding an ordinary plough. I have found this to be an excellent practice. It substitutes potatoes wholly or in part for lea oats, which is a precarious crop. In spring the crusts of the sod are broken down with the harrow or grubber. The ground is ridged or drilled by the double moved board plough; the farmyard manure is spread in the drills; the artificial manure is spread over it; the "setts" (cut potatoes) are placed over both, at a distance of 12 inches from sett to sett; the whole is covered by splitting the drills again with the double moved board plough. When the plants appear well upon the surface they are moulded, the soil having been previously loosened with the grubber, and weeds removed. After a time the soil between the drills is again stirred with a drill-grubber, and, when necessary, a drill harrow, and the plants again moulded. At all times weeds should be kept down; for weeds absorb the nourishment which should go to sustain the potato crop, and choke the crop. If half the lea field is cropped with potatoes, and the other half cropped with lea oats, and if the potato and lea be altercated in the same field afterwards, potatoes do not recur on the same land, in the fair course of rotation, oftener than once in eight years. In the ordinary course of cropping land in rotation the potato usually follows lea oats; that is, the crop occupies the same place in the rotation as root crops. In this case the ground is ploughed deeply as early in autumn as possible; and when the proper time for planting arrives the ground is cross-ploughed, harrowed, and made into drills, the manure is applied, and the crop planted and treated as already described. We sow the main crop in March, using about 100 (imperial) stones per square acre. The small farmer raises the crop in lazy beds; and, for reasons already assigned, this is the best system in undrained and unimproved land. The ground should be dug as deeply and early as possible. The more thoroughly the surface is prepared the better. Sometimes in Ireland it is not stirred at all, the crop being raised on the untilled surface. In place of this I advise the ground to be well broken up; and I recommend that the "setts" shall be deposited in regular rows or lines across the ridges, so that the soil between the rows may be forked or hoed, and the crop moulded properly from the furrows. The farm yard or house manure is to be spread on the ridges; the artificial manure, if used, is spread over it, and the setts are dropped in rows from 18 inches to 24 inches asunder, the distance from sett to sett being from 9 inches to 12 inches, according to the soil. In the after-cultivation the ground must be loosened sufficiently, and weeds kept down. I may add that it is no uncommon thing to find 12 tons of weeds in an acre of potatoes in Ireland.

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Mr. *Earp.*

2709. I think there is one point we have hardly cleared up with regard to the resting spores. Do you say that the resting spores will continue vital in the haulm of the potato?—No; what I said with regard to the resting spores is that everything we know as to their remaining in the ground rest entirely on the authority of Mr. Worthington Smith.

2710. Then if they would not rest, and would not remain vital in the haulm, there can be no necessity to destroy the haulm. You do not attach much importance to that, do you?—I do not. My view of that point is simply this: that it is better to err on the safe side. Further than that I really do not go.

2711. I think you said that the agricultural progress of this country has been pressed on by the force of accumulated wealth?—Yes, that is my idea.

2712. Can you just enlarge upon that view a little; why do you say that?—I shall indicate to you what is in my mind. Your exceptional agricultural condition in England I hold is entirely owing to the fact that money was made, and largely made, in manufacturing industries, and in trade and commerce, and, I believe, that an enormous proportion of the surplus capital overflowed to the land. That did not take place in Ireland; there has been no such overflow in the south of Ireland; there has been no such overflow in the west of Ireland, and no such overflow in any part of Ireland, except in parts of Ulster, and I believe it has been forced on in that way by the capital that has come from these sources, as it were, to the land.

2713. Then you think the tendency which would otherwise have manifested itself in England, as well as in Ireland, to agricultural loss and difficulty has been counteracted by those means?—I am quite clear that it has.

2714. You use the argument simply as showing that we not do owe immunity from the unfortunate state of things in Ireland to our extra care and experiment?—That is precisely my contention.

2715. So that you wish us to understand that you consider care and these experiments, even in England, would necessitate less reliance upon this wealth?—Yes; it would certainly.

2716. Can we get on record your opinion as to the reason why private enterprise is insufficient, and Government direction so necessary with regard to experiments?—Experience has told us that private enterprise is not equal to the emergency, and that in all foreign countries where there is progress, the Government is co-operating with private enterprise, as, for instance, in the case of Germany; there is an association in Aberdeenshire which owes its existence entirely to a number

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Mr. *Earp*—continued.

ber of highly public spirited men; they have got a chemist, who has made several reports which I have here; now it appears to me that if there had been a Minister of Agriculture co-operating with a society of this kind, the reports never would have been published in their present form; I will quote one passage to show what I mean; in their first report they state what is, I believe, an agricultural heresy, that, "probably the most economical manure for turnips is phosphate of lime from any source, ground to an impalpable powder;" now if that view should be right, all the manure manufactories, and all the capital invested in the manure trade, would be simply wasted, and causing a great loss to the farmers. My actual experience is at total variance with that, and I have possibly made more experiments than most people. If there had been a Department of Agriculture, such a doctrine as that would never have been written.

2717. According to that, it is evident that your opinion is, that private enterprise is not directed generally with sufficient care and intelligence, that its resources are inadequate, and that it moves more slowly and in a more haphazard fashion than the circumstances require?—Yes, that is my view, and that a combination of the two. I would bring into play local enterprise.

Mr. *Arthur Moore.*

2718. Just to bring it to a practical conclusion, do you believe that a change of potato seed from time to time is necessary?—I do.

2718. That, I take it, would mean that new varieties should be propagated?—Yes.

2720. Do you believe that that cannot be done satisfactorily by private enterprise, and could only be done on a large scale?—I am quite clear upon that.

2721. That it is too costly to pay the ordinary farmer?—Experimental work will not pay the ordinary farmer at all.

2722. And some experimental work is necessary to supply us with scientific knowledge of agriculture?—I believe you can have no progress without it; certainly not in Ireland.

2723. Your view is this, that you think some State control or State assistance is very desirable?—That is my view.

APPENDIX.

LETTER from Mr. *Murray*, referred to in Mr. *Baldwin's* Evidence.

Appendix.

In the middle of August 1876, I instituted the following experiment, with the object of determining the mode of diffusion of the conidia of *Phytophthora infestans*.

The method of procedure was, to expose on the lee side of a field of potatoes, of which only about two per cent. were diseased, ordinary microscopic slides, measuring two inches long by one inch broad, coated on the exposed surface with a thin layer of glycerine, to which objects alighting would adhere, and in which, if of the nature of conidia, they would be preserved. These slides were placed on the projecting stones of a dry stone wall which surrounded the field, and was at least five yards from the nearest potato plant. During the five days and nights of the experiment, a gentle wind blew, and the weather was, on the whole, dry and clear. Every morning, about nine o'clock, I placed 14 slides on the lee side of the field, and every evening, about seven o'clock, I removed them, and placed others till the following morning at nine o'clock. The 14 slides exposed during the day, when examined in the evening, showed (among other objects), on the 1st day, 15 conidia; on the 2nd, 17 conidia; on the 3rd, 27 conidia; on the 4th, only four conidia; and on the 5th, nine conidia. On none of the five nights did a single conidium alight on the slides. This seemed to me to prove that during the day the conidia, through the dryness of the atmosphere and the shaking of the leaves, became detached and wafted by the atmosphere; while during the night the moisture (in the form of dew, and on one occasion of a slight and gently falling shower) prevented the drying of the conidia, and thus rendered them less easy of detachment.

I determined the nature of the conidia (1) by comparing them with authentic conidia directly removed from diseased plants; (2) by there being attached to some of them portions of the characteristic conidiophores; and (3) by cultivating them in a moist chamber; the result of which was, that five conidia, not having been immersed in the glycerine, retained their vitality, which they showed by bursting and producing 200 spores in the manner characteristic of *Phytophthora infestans*.

The fact that on the limited space thus exposed 72 conidia fell during 60 hours, from a field bearing about two per cent. of diseased plants, shows that the diffusion of the conidia by the atmosphere is an ordinary mode of spreading the disease.

Geo. Murray.

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CHAMPION:

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DISEASE:

1. *As to the Origin and Development of the Potato Disease.*
2. *As to the Fungus or Fungi which constitute the Disease.*
3. *As to the Spread or Conveyance of the Disease, and the Existence and Effect of Resting Spores.*

1. *As to the Origin and Development of the Potato Disease:*

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2. *As to the Fungus or Fungi which constitute the Disease :*

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Grounds for dissenting from Mr. Carruthers' view that the disease is carried considerable distances in the air or by the wind; reference hereon to a recent experiment by Mr. Murray, *Baldwin* 1832–1843. 1849–1851. 1928–1930——Expediency of a large reward being offered by Government for discovery of the mode in which the disease is propagated, *ib.* 1844——Belief as to the accuracy of Mr. Worthington Smith's conclusions as to the existence of resting spores, *ib.* 1852–1857.

Concurrence of witness in the view that the spores can be carried a considerable distance by the wind, *Voelcher* 1943, 1944. 1989–1991. 2006–2009——Conclusion as to the resting spores remaining in the land for a very long time, these being the principal source of propagation of the disease, *ib.* 1945, 1946. 1984–1986. 1988. 2004, 2005.

Discovery by witness after careful investigation of the resting spores of the potato fungi, *Smith* 2088–2090——Information as to the action of the resting spores in spreading disease through the air, and in attacking several other plants besides the potato, *ib.* 2094. 2120–2122. 2132–2149. 2251–2256——Conclusion as to the resting spores being almost the only mode of propagating the disease from year to year, either in the ground or through the air, *ib.* 2120–2151——Frequent existence of resting spores in old seed tubers; these should be burnt, *ib.* 2123–2126——Immense distance for which the spores may be carried by the wind, *ib.* 2147–2149.

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Enormous number of spores produced by a single fungus, the disease being spread with great rapidity, *Rep.* iii, iv——Great importance attached by some of the witnesses to resting spores, *ib.* iv.

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Dublin County. Extensive cultivation of potatoes by some growers in Dublin County, the seed being generally imported from Scotland, *Robertson* 1146–1151——Practice in Dublin County of planting early sorts in January if the weather is favourable, *ib.* 1280–1282.

Dyer, W. T. Thistleton. (Analysis of his Evidence.)—Witness, who is Assistant Director of the Royal Gardens at Kew, has paid considerable attention to the subject of the potato disease, and the present state of scientific knowledge on the matter, 1, 2.

Illustration, by means of a diagram prepared by Mr. Worthington Smith, of the origin and operation of the disease, which is caused by the depredations of a fungus upon the plant, 3——Definition of the potato fungus as a mould which attacks the tissues of the plant and destroys its life, *ib.*——First appearance of the disease usually in the autumn or late summer after periods of warm rain, and in the form of a yellowish tinge upon the foliage of the plant, *ib.*

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Essex. Large quantity of potatoes grown in Kent and Essex; different kinds of manure used in the latter county, *Shuter* 2338-2344.

Experiments. Evidence as to the expediency of experiments with a view to the production of new varieties of the potato, *Dyer* 89-91; *Carruthers* 151-157. 164-166. 202-206; *May* 1352-1361. 1389, 1390——Advantage if experiments in Scotland were encouraged by the Highland Society, *Ritchie* 1052——Unfavourable result of some experiments by witness' father in 1847 in the cultivation of the wild potato from Peru, *Ingram* 1666. 1673-1675. 1780-1782.

Suggestions with a view to a system of Government experiments, *Smith* 2220-2243. 2313, 2314——Expediency of continued and various experiments under Government in reference especially to the potato disease; other steps necessary with a view to stamping out the disease, *Baldwin* 2571, 2572. 2581-2586——Importance of experiments upon a great variety of farms and of soils; valuable aid expected from local enterprise, *ib.* 2591-2595.

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F.

Flounder Potato. Witness has heard very favourable accounts of the Flounder, *Nichol* 442——Reference to the Flounder as a very good potato and a large cropper, though inferior in quality to the Kemp, *Robertson* 1111–1115——Excellent crops given by the Flounder; liability to disease if not dug early, *Baldwin* 2539.

Flowering Potatoes. Reason why flowering potatoes degenerate, *Shuter* 2408. 2435–2437.

Forced Potatoes. Presence of the disease among potatoes grown under glass in February, *Carruthers* 167, 168.

Foreign Varieties. Very unfavourable results from the trial of foreign varieties by witness, *May* 1406——Inferiority of foreign seed potatoes as compared with English, *Ingram* 1667, 1668. 1697——Preference of the public for English as compared with foreign potatoes; information as to those now imported, *Shuter* 2423–2425. 2438–2443.

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Frost. Risk incurred from frost by planting in November, though maturity before the late summer is most desirable, *Carruthers* 211–214.

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"*General Grant*" *Potato.* Less disease in the case of the "General Grant" than of several other varieties, *Carruthers* 233–237.

German Reds. Demand of the London public for German Reds in preference to Champions, *Shuter* 2395, 2396.

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Glasnevin (*Dublin*). Total of 180 acres comprised in the farms at Glasnevin; last year about 100 acres were under rotation of crops, including twelve acres of potatoes, *Baldwin* 1797–1801——Average produce at Glasnevin in 1879 of rather more than six tons per statute acre; this was four or five times the average of the whole country, *ib.* 1802——Particulars as to the different varieties grown at Glasnevin, and the result as regards disease; very small per-centage of disease in the Champion as compared with the old varieties, *ib.* 1803–1806. 1908–1911——There are three acres devoted to experiments, and in 1879 there were fifty-three distinct varieties grown, *ib.* 1803.

Further information as to the results of experience at Glasnevin in regard to the qualities and produce of different varieties of potatoes, and their relative liability to disease, *Baldwin* 2539.

Explanation relative to the great value conferred upon the country by the education of students at Glasnevin, and the experiments as to crops and manure; cost of the institution on the other hand, *Baldwin* 2548–2561. 2564–2566——Valuable light thrown by Glasnevin upon the subject of contagious cattle diseases, *ib.* 2558. 2559.

Proposal for the re-constitution of the Glasnevin establishment as an entirely independant department of agriculture; explanation and suggestions in detail as to the operations of such department in reference to potato cultivation, &c., *Baldwin* 2562 *et seq.*

Extended operation of the Glasnevin Institution beyond the objects originally contemplated, *Baldwin* 2586–2590——Description of the plan of cultivation of potatoes at Glasnevin, together with a statement of the cost of ploughing, manure, seed, &c., *ib* 2708.

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Opinion that the production of disease-proof potatoes should be left to economic laws and to private enterprise rather than be taken up by the State, *Dyer* 82. 126–128. 131–133——Expediency of some encouragement by Government or by Agricultural Societies with

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Suggestions in detail for the establishment of seed potato farms under Government superintendence in different parts of the country; several important objects to be attained thereby, such as the distribution of good seed at a reasonable price, the introduction of new varieties, &c., *Ingram* 1610-1614. 1638-1660 1684-1687. 1727-1730. 1751-1770. 1773-1779.

Suggestions as to the way in which Government might aid in the production of new varieties; advantage of local schools of Agriculture or Government farms, as in Ireland, *Baldwin* 1894, 1895. 1913-1926. 1937, 1938——Advantage of Government encouragement to the production of new varieties and improved modes of culture, *Voelcker* 2015-2017.

Proposed formation by Government of an experimental potato farm, in which improved varieties capable of resisting disease might be grown, *Smith* 2094. 2190-2193. 2236, 2237. 2240-2243—— Plan proposed for ascertaining full particulars relative to the cultivation of potatoes throughout the kingdom, and for circulating at the same time useful instructions and information on various points, *ib.* 2094. 2222-2237.

Importance further attached to a system of Government experiments in view of the enormous loss to Ireland by the disease, and of the improvements to be effected; conclusion as to the matter being beyond private enterprise, *Smith* 2220-2243. 2313, 2314 ——Importance of Government aid in the development of new varieties, and in strengthening old varieties, *Shuter* 2384-2390. 2421, 2422.

Various kinds of experiments contemplated on the large Government farms proposed by witness; limited number of such farms required, *Baldwin* 2581-2585——Valuable Government aid given in France, Germany, the United States, and other foreign countries in the matter of agricultural improvement, *ib.* 2606-2616.

Grounds for concluding that Government co-operation with private enterprise is essential in the interests of agriculture, with a view to the production of new varieties of the potato, *Baldwin* 2716-2723.

Conclusion of the Committee that experimental undertakings for the creation and establishment of new varieties should be encouraged by Government in England, Scotland, and Ireland; alternative modes by which this may be done, *Rep.* vi—— Proposed appointment, as an alternative course, of a superintendent in England and in Scotland who should conduct experiments, and should endeavour to furnish new and successive disease-resisting varieties, *ib.*——Conclusion that the time has arrived for Government assistance in the creation of new varieties, *ib.*

Grass Land. Explanation in regard to the good potato crops given by grass land broken for the first time, *Baldwin* 2622-2626.

Guano. Belief that the potato disease was first imported in guano from Peru, *Baldwin* 1812-1817——Dissent from the view that there is anything in Peruvian guano calculated to engender disease, *Voelcker* 1973, 1974.

H.

HAULMS OR STALKS:

Possibility of the stalks carrying the disease from one year to another; expediency on this score of the stalks being burned rather than used as manure, *Dyer* 31-35. 122—— Disadvantage connected with the cutting away of the haulms on the first indication of disease, *ib.* 97, 98——Importance of the haulms being always burned instead of being placed on the dung heap; danger otherwise from the resting spores, *Carruthers* 146. 150, 151. 192, 193, 219. 239, 240——Injurious effect upon the tuber by cutting off the stalks when the disease appears, *ib.* 196.

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Objection to potato refuse being used for manure; importance of burning the stalks and the rotten potatoes, *Robertson* 1209-1211. 1269-1275. 1287, 1288. 1294, 1295—— Circumstance of the stalks having been repeatedly ploughed into the land by Mr. Laws without any injurious result, *ib.* 1211——Practice of witness not to burn the haulms of diseased potatoes; doubt as to any advantage in cutting off the haulms, *Coleman* 1464. 1507-1512.

Expediency of digging up the potato when the haulm no longer gives it any help, *Ingram* 1664, 1665——Advantage in dusting the haulms with charred wood when the disease first appears, *ib.* 1698-1700——Importance of destroying the haulm, *ib.* 1737.

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Approval of the stalks being burned, though witness does not attach much importance to this precaution, *Baldwin* 1858, 1859. 2653, 2654. 2709, 2710——Importance of burning the haulms and other refuse, *Voelcker* 1980; *Shuter* 2356, 2357.

Importance of all potato refuse being completely burned every autumn, and never being ploughed into the land, *Smith* 2094. 2155–2159. 2162. 2285–2287——Advantage if it were compulsory to burn decaying stalks and other refuse, *ib.* 2155–2158. 2162. 2257. 2285–2287. 2236–2301.

Concurrence of evidence as to the expediency of burning the stalks of diseased potatoes, *Rep.* iv.

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Hybernation of Disease. Data for the conclusion that the disease is carried on from one year to another by means of filaments of the fungus, which apparently pass into a dormant condition in the tubers in the seed potato, *Dyer* 3, 4. 74–77——Doubt as to the resting spores living through the winter in the haulms and thus perpetuating the disease, *ib.* 3. 58, 59——Very little chance of the disease being communicated from the ground if not planted with potatoes two years in succession, *ib.* 24——Explanation that witness considers the disease spreads from the tuber, and is thus hybernated, *ib.* 31. 36–42. 56. 101. 109. 112–117.

Possibility of the disease being sometimes carried over from one year to another by means of diseased tubers which are planted, *Carruthers* 146——Difficulty in accounting for the disease being carried over the winter, *ib.* 146. 149——Witness believes in the resting spores, Mr. Worthington Smith having discovered that they remain in the ground during the winter, *Ingram* 1173. 1738.

Hybernation of the resting spores of the Peronospora Infestans for a period up to three years, whilst those of the Fusisporium Solani seldom hybernate for a period longer than from three months to one year, *Smith* 2094. 2103–2106. 2142, 2143. 2317–2319.

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Hybridising. Experiments being made by witness in the production of different varieties by grafting two kinds upon each other *Nichol* 381–383——Value of hybridising as a means of obtaining a strong growing plant, *Baldwin* 1908. 2652.

I.

IMMUNITY FROM DISEASE (*PREVENTIVE MEASURES*):

Doubt whether the potato has ever been really free from disease, *Dyer* 12–14——Great importance of guarding against the planting of diseased potatoes and of taking practical precautions otherwise in view of the liability to infection, *ib.* 44–47. 83, 84. 119–125. 135–142——Evidence to the effect that immunity from disease can best be attained by the use only of certain kinds of potato which experience has proved to be free, or, to a large extent free, from liability to infection, *ib.* 48, 49. 71. 80. 82–84. 118.

Much greater freedom from disease of some varieties than of others in the same district, though no variety is actually disease-proof, *Carruthers* 228–237——Suggestions as to the steps desirable in the production of new varieties with a view to obtaining disease-proof kinds; prospect of this result being obtained, *Nichol* 394–399.

Importance of growing from seed and of obtaining new varieties as the best means of guarding against disease, *Rintoul* 818–836——Failure of attempts by witness to check the disease, the best or only preventive being a change of seed, *ib.* 904–909. 936–938.

Reiteration of the view that change of seed and the introduction of new varieties are the main remedies required, *Robertson* 1118, 1119. 1145–1151. 1232——Circumstance of the potato fungus having entirely disappeared in a certain district towards the close of last season, *Ingram* 1747.

Belief that it is quite possible to extirpate the disease; that is, chiefly by providing that no potatoes raised in one year shall be planted in the next year, and that all fresh seed should be imported from the Colonies, *Baldwin* 1818–1827——Illustration in the case of the foot-and-mouth disease of the practicability of stamping out the potato disease, *ib.* 1822–1825.

Suggestion that an experiment be conducted on an island near the coast so as to decide the question whether by certain precautions the disease may not be eradicated; commission of competent men by whom the experiment should be carried out, *Baldwin* 1829–1831. 1836. 1844–1847——Belief as to the facility of procuring perfectly healthy

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potato seed from India and the United States if the disease were stamped out in Ireland, *Baldwin* 2617, 2618.

Successful experiments by witness in 1873 and subsequent years; data upon which he submits that he has discovered a method of entirely obviating the disease, *Thompson* 2035–2048. 2082–2087——Offers made by witness to the Royal Agricultural Society and the Market Gardeners' Association with a view to a fair trial of his discovery, and to his being remunerated if successful; failure of his proposals to these bodies, *ib.* 2049–2056. 2080——Readiness expressed by witness to demonstrate the working and the success of his method of cultivation, under certain conditions as to his being fairly remunerated provided he is successful, *ib.* 2057, 2058. 2072–2082.

Evidence as to the great advantage by circulating official information as to the soils and climates best suited for potato culture, and as to the best varieties of plant to be grown, *Smith* 2094. 2222–2237——Conclusion that any attempt to stamp out the disease (in the way suggested by Professor Baldwin) would be perfectly futile, *ib.* 2094——Hopelessness of cure when once the potato has the murrain decidedly upon it, *ib.*

Advantage of individual responsibility in connection with witness' scheme for dealing comprehensively and effectualy with the existing evil, *Smith* 2094——Various preventive measures recommended with a view to a material reduction of the disease, *ib.*

Apprehension that the disease cannot be entirely got rid of by any amount of precautions, *Voelcker* 1981–1984. 1995, 1996——Importance of producing a better physical condition in the plant as giving immunity from disease, *Shuter* 2357. 2448.

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Ingram, William. (Analysis of his Evidence.)—Extensive experience of witness in the cultivation of the potato, and in carrying out experiments; he is now in charge of the gardening operations at Beauvoir Castle, 1588–1592——Disadvantage in witness having to grow potatoes on a clay soil; special kind of manure used, and special mode of planting adopted, in order to counteract this disadvantage, 1592–1600. 1627–1630. 1718–1724——Use chiefly of charred vegetable matter, or burnt earth, as a manure; great value thereof, 1592. 1600. 1676–1683. 1701. 1706–1713.

Explanation that witness plants potatoes on the surface, and after dusting them with charred refuse, earths them up with a hoe, 1592——Large immunity from disease under the system carried out by witness, 1592–1599——Importance attached to an extended growth of early potatoes which mature before the season when the disease usually appears, 1593–1595. 1615–1620. 1635–1637. 1648–1658. 1661–1663. 1688, 1689——Great importance attached also to a selection of sorts and of seeds, 1594. 1596. 1603–1605. 1612–1614.

Disapproval of farm-yard manure or stimulating manure, 1600. 1681, 1682. 1704, 1705. 1714–1717——Value of certain precautions in the storing of seed, as well as in its selection, 1601–1609. 1632–1634——Importance of a choice of ground or soil, and of experiments to this effect, 1602. 1650–1660——Instances of the gradual exhaustion of particular varieties, 1606——Entire failure of the Dalmahoy on witness' soil, 1606. 1653–1655.

Suggestions in detail for the establishment of seed-potato farms under Government superintendence in different parts of the country; several important objects to be attained thereby, such as the distribution of good seed at a reasonable price, the introduction of new varieties, &c., 1610–1614. 1638–1660. 1684–1687. 1727–1736. 1751–1770. 1773–1779.

Successful cultivation of potatoes in Jersey; advantage in the soil being composed very much of decomposed granite, 1621–1626——Reasons for concluding that the production of good seed and of new varieties could not be so beneficially carried out through the agency of agricultural societies as by Government directly, 1638–1647——Importance of a change of soil, and of not growing too frequently on the same land, 1650–1660. 1669. 1718–1726. 1748–1750.

Expediency of digging up the potato when the haulm no longer gives it any help, 1664, 1665——Unfavourable result of some experiments by witness' father in 1847 in the cultivation of the wild potato from Peru, 1666. 1673–1675. 1780–1782——Inferiority of foreign seed potatoes as compared with English, 1667, 1668.

Approval of the use of soot as a manure, 1690, 1691. 1697. 1702, 1703——Advantage in dusting with burnt earth or quick lime when potatoes are pitted, 1692–1696——Advantage also in dusting the haulms with charred wood, when the disease first appears, 1698–1700——Inadequacy of private enterprise as a means of obtaining new and improved varieties; very little done by seedsmen or market gardeners in this direction, 1731–1736. 1762–1770. 1776–1779.

Witness believes in the resting spores, Mr. Worthington Smith having discovered that they remain in the ground during the winter, 1737, 1738——Activity given to the disease

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disease in certain states of the atmosphere, whilst the spores are carried long distances by the wind, 1739–1743——Value of sulphur for the destruction of fungi; witness has not applied it to the potato plant, 1744–1747. 1771, 1772——Circumstance of the potato fungus having entirely disappeared in a certain district towards the close of last season, 1747.

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Great danger in the population of Ireland depending too largely on the potato crop, *Carruthers* 216; *Voelcker* 2010——Large export of Irish potatoes for seed to the West of England and Wales, *Robertson* 1120–1122——Very defective cultivation by the cottiers, *ib.* 1152–1160. 1206–1208.

Extensive experience of witness in the cultivation and sale of potatoes in the North of Ireland; considerable export by him from Londonderry, *Coleman* 1415–1419. 1432, 1433. 1495–1499——Import of potatoes and of potato seed by witness, the Champion being the best, *ib.* 1433, 1434. 1443, 1444——Information as to the time of planting in the North of Ireland, the mode of cultivation, &c., *ib.* 1436–1442. 1579–1586.

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Nichol, John. (Analysis of his Evidence.)—Information as to the steps taken by witness at Ochterloney in 1862 and subsequently, which resulted in the production of the Champion potato; selection in the first instance of a large number of plants which he gradually reduced to a small number of the best varieties, 363-375——Opinion that a seedling potato will attain its characteristics in five or six years, and that it may further improve in quality after that period by proper treatment, 376——Improvement in the quality of the Champion since it has become less strong in the haulm, 377.

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——Tendency to development of disease when potatoes are stored in pits; improvement desirable as to storage, *Carruthers* 146. 152——Advantage of storing potatoes in a dry place, with a good circulation of air about them, *ib.* 170. 242, 243.

Precautions desirable in order to prevent the development of disease in pits, *Nichol* 430–434——Practice of witness always to store in pits; particulars hereon, *Nicoll* 530, 531. 621–636——Practice of witness as to storing pits, and covering with straw, an escape being made for heated air, *Rintoul* 726–729——Liability to spread of the disease when the potatoes are stored early by way of anticipating infection in the fields, *ib.* 929–932——Adoption by witness of the usual plan of storing and of covering with wheat straw, leaving space for ventilation, *ib.* 1030–1032——Large proportion of witness' store potatoes which turned out bad last year, *ib.* 1040–1043.

Approval of pitting when the potatoes are kept for food, whilst house storage is best for seed purposes, *Robertson* 1293——Practice of witness as to storing potatoes in pits, *Coleman* 1492–1497——Advantage in dusting with burnt earth or quicklime when potatoes are pitted, *Ingram* 1962–1696.

Great mischief through the improper storage of potatoes; improvements suggested on this point, *Smith* 2094. 2152. 2154——Strong disapproval of storing in pits, *ib.* 2152——Views of witness as to the storing of potatoes; system in France of storing early seed potatoes on shelves or small trays, *Shuter* 2409–2413——Suggestions as to storage and as to the best form of pits, *Baldwin* 2631–2633.

Sulphur. Value of sulphur for the destruction of fungi; witness has not applied it to the potato plant, *Ingram* 1744–1747. 1771, 1772.

Sutton's Red Skin Flour Ball. Merits of this potato, *Smith* 2199, 2201——Very small quantity of starch in Sutton's Flour Ball, *Shuter* 2394. 2449–2452.

T.

Thompson, Henry. (Analysis of his Evidence.)—Considerable amount of potatoes formerly grown by witness for the London market; very heavy loss from disease in 1872; 2018–2034——Successful experiments by witness in 1873 and subsequent years; data upon which he submits that he has discovered a method of entirely obviating the disease, 2035–2048. 2082–2087.

Offers made by witness to the Royal Agricultural Society and the Market Gardeners' Association with a view to a fair trial of his discovery, and to his being remunerated if successful; failure of his proposals to these bodies, 2049–2056. 2080——Readiness expressed by witness to demonstrate the working and the success of his method of cultivation, under certain conditions as to his being fairly remunerated provided he is successful, 2057, 2058. 2072–2082——Experience of witness in the cultivation of Dalmahoys; value of this variety, though it is sometimes much cut up by frost, 2061–2071.

Tomatoes. Limited extent to which the potato disease attacks other plants such as the tomato; doubt as to the disease being carried on from year to year by this means, *Dyer* 24–30——Extensive destruction of the tomato by the same disease which attacks the potato, *Smith* 2094. 2322, 2323.

Tubers. Circumstance of diseased tubers sometimes producing perfectly healthy foliage, *Dyer* 43——Dissent from the view that vegetative reproduction from tubers tends to an increase of disease as compared with production from seeds, *ib.* 50, 51. 90. 110, 111——Operation of the disease as regards respectively the foliage and stalk, and the tuber; immunity as a rule of the latter if the former appears healthy, *ib.* 53–57. 72, 73. 102, 103.

Equal liability to disease by growing from seed as by using the tubers, *Carruthers* 171, 172——Expediency of the most healthy tubers being selected in planting, *Nichol* 441——Importance of a careful selection of tubers so that those varieties least liable to disease may be used for general cultivation, *Smith* 2094——Different results in growing from the tuber and from seed, *Baldwin* 2651, 2652.

See also *Disease.* *Seed.*

U.

Ulster Model Farm. Explanation as to the failure of the Ulster Model Farm at Belfast, *Baldwin* 2658–2665.

V.

Victoria Potato. Uncertain crops now produced by the Victoria, *Nichol* 384——Greater liability of the Victoria to disease than in former years, *Rintoul* 847. 851–853——Preference for the Victoria over any other kind of potato, *ib.* 907.

Advantage in planting Victorias uncut, *Ritchie* 970–973——Opinion that the Victoria is becoming more susceptible to disease, *ib.* 994, 995——Patterson's Victoria is the best kind known to witness, *Smith* 2200—— Good quality maintained by the Victoria, *Shuter* 2391, 2392.

Vine Disease. Means adapted in France for stamping out the vine disease, *Baldwin* 2702.

Voelcker, Dr. Augustus, PH.D., F.R.S. (Analysis of his Evidence.)—Long experience of witness as Consulting Chemist of the Royal Agricultural Society of England; he has devoted much study to the potato disease, 1939–1941.

Agreement among scientific men as to the potato disease being a fungus (Peronospora infestans), 1942——Concurrence of witness in the view that the spores can be carried a considerable distance by the wind, 1943, 1944. 1989–1991. 2006–2009——Conclusion as to the resting spores remaining in the land for a very long time; these being the principal source of propagation of the disease, 1945, 1946. 1984–1986. 1988. 2004, 2005.

Liability to the disease whatever amount or quality of manure may be used; mitigation, however, by good cultivation and proper manuring, 1948. 1976. 1995, 1996. 2003——Importance of an early supply of manure, and of the manure being thoroughly distributed before the potatoes are planted, 1948–1950, 2001, 2002——Suggestions relative to the application of potash; excellent results when used in conjunction with phosphate of lime and ammonia, 1950. 1954–1962. 1966–1972. 1998–2000. 2011–2014——Value of seaweed as a manure; it should be applied in the autumn, 1951–1953. 1963.

Special importance of applying potash to the soil in Ireland; calculation that it would repay the cost over and over again, on account of the increased production, 1957–1962. 1966–1968. 2011–2014——Relative value of artificial manures and of farm-yard manure, 1962. 1976–1979 ——Dissent from the view that there is anything in Peruvian guano calculated to engender disease, 1973, 1974.

Expediency of burning the haulms and other refuse, 1980——Importance of a proper rotation of crops, 1980. 2003—— Importance also of encouraging the growth of new varieties, *ib.* ——Apprehension that the disease cannot be entirely got rid of by any amount of precautions, 1981–1984. 1995, 1996——Appearance of the disease in wet seasons, irrespective of the electrical state of the atmosphere, 1992–1994——Wood ashes form an excellent manure, 1997.

Views of Baron Liebig as to the importance of a proper condition of the soil as enabling the plant the better to resist disease, 2003——Great danger in the population of Ireland depending so largely on the potato, 2010——Advantage of Government encouragement to the production of new varieties and improved modes of culture, 2015–2017.

W.

Weather (*Wet Seasons*). Belief that thunder or atmospheric electricity has nothing to do with the disease whilst heat and rain tend to develope it, *Dyer* 64–69. 73. 81——Requirement of heat as well as rain for the development of the disease, *Carruthers* 195——Appearance of disease usually in September; rapid progress made in close, muggy weather, *Nicoll* 568–572. 605–607——Exceptional cases of disease in dry seasons in particular soils and localities, *Rintoul* 894–896——Exemption from disease in dry seasons, *Ritchie* 1057–1059.

Frequent appearance of disease after storms of thunder and lightning especially in wet seasons; this was specially the case in 1879, *Robertson* 1162. 1183–1189. 1278, 1279. 1303, 1304——Concurrence in the statement as to the frequent appearance of the disease after thunderstorms in wet seasons, *May* 1371–1374——Appearance of the disease usually after heavy rains, *Coleman* 1529–1534.

Exceptional character of last season as regards temperature, rainfall, and cloudiness of the sky, *Baldwin* 1794——Appearance of the disease in wet seasons irrespectively of the electrical state of the atmosphere, *Voelcker* 1992–1994——Development of the potato fungi and resting spores by heat and moisture, *Smith* 2271–2274.

Effect of electrical states of the atmosphere in developing and promoting the disease, *Shuter* 2347–2351. 2444–2447——Cause of the greater prevalence of disease in England than abroad, *ib.* 2484–2486.

Weather (Wet Seasons)—continued.

Effect of moist weather and electrical states of the atmosphere in the development of the disease, *Rep.* iv.

Wild Plants. Successful resistance of the disease by several wild plants, as being more hardy than the potato, *Smith* 2094. 2172–2174.

Wood Ashes. Beneficial use of wood ashes as manure when witness was in Canada, *Crighton* 351–355——Instances of the unsatisfactory results of the use of wood ashes as manure, *Ritchie* 1060–1063——Wood ashes form an excellent manure, *Voelcker* 1997.

Woodland. Objection to planting potatoes in or near woodland or in sheltered land, *May* 1366–1370. 1386. 1396–1399. 1404, 1405; *Coleman* 1459, 1460. 1528.